WESTBROOK BOARD OF EDUCATION
EDUCATE, CHALLENGE, & INSPIRE

WESTBROOK BOARD OF EDUCATION
Teaching and Learning Subcommittee Meeting
Tuesday, December 12, 2023 @ 5:30 p.m.
Superintendent's Office

AGENDA

I. Call to Order

II. Approval of Minutes of October 10, 2023

III. Math K-8
Forensics and Chemistry

IV. Next meeting and suggested agenda topics

V. Adjourn

WESTBROOK BOARD OF EDUCATION
EDUCATE, CHALLENGE, & INSPIRE

Teaching and Learning Subcommittee Meeting

Tuesday, October 10, 2023 @ 5:30 p.m.
WHS Library

MINUTES

Members Present: C. Kuehlewind, D. Perreault, K. Walker

Also Present: Superintendent Martineau; A. Saba, Curriculum Leader

I. Call to Order: The Teaching and Learning subcommittee meeting was called to order at 5:30 p.m. by C. Kuehlewind, Chair, in the WHS library.

II. Approval of Minutes of June 7, 2023: MOTION by D. Perreault and SECOND by K. Walker to approve the minutes of June 7, 2023. Vote unanimous.

III. ELA – Grades 3-8: Reviewed revised curricula and recommended moving forward to BOE meeting for approval.

IV. Update on K-3 Reading Mandates: Discussion of reading mandates and K-3 Amplify pilot. New grants for CSDE fully fund pilot ($84,000).
- Overview
- Right to Read Grants
- CSDE Reading PD

V. Social Studies – Gr. 3 & 4 - Reviewed revised curricula and recommended moving forward to BOE meeting for approval.

VI. Next Meeting - December 12 @5:00 p.m.
Suggested agenda topics:
Math K-8
Forensics and Chemistry

VII. Adjourn: MOTION by D. Perreault and SECOND by K. Walker to adjourn at 6:20 p.m. Vote unanimous.

Respectfully submitted,
Christine Kuehlewind, Board Secretary Cecilia S. Lester, Board Recording Clerk

TBA at next meeting

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 1: Numbers All Around Us
Pacing	4 weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

1.OA.4 Solve subtraction problems by finding an unknown addend
1.OA.5 Solve addition and subtraction problems by counting on and counting back

1.OA.6 Add within 20
1.OA.8 Solve for the unknown in an addition equation involving 3 whole numbers (2 addends and a sum)
1.NBT.1 Count to 120, starting with any number less than 120, including 0 or 1
1.NBT.1 Read and write numerals to 120
1.NBT.1 Represent a number of objects with a written numeral up to 120
1.NBT.2b Demonstrate an understanding that numbers from 11 to 19 are composed of a ten and some more ones

Supporting Standards:

1.MD.2 Measure the length of an object by laying multiple copies of a shorter unit end to end (iterating)
1.MD.2 Express the length of an object as a whole number of units
1.MD.2 Demonstrate an understanding that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps
1.MD.4 Organize, represent, and interpret data, and answer questions about the total number of data points in a set of data with up to 3 categories
1.G.2 Create a composite shape by composing two-dimensional or three-dimensional shapes

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students* ***do****?*	**Concepts** *What must students* ***know****?*
1. Count by 2's to 20.	1. Forward/Backward counting sequence to 100 and counting sequence by 2's, 5's and 10's
2. Group and count objects by 5s.	2. Forward/Backward counting sequence to 100 and counting sequence by 2's, 5's and 10's
3. Count by 10s to 100.	3. Forward/Backward counting sequence to 100 and counting sequences by 2's, 5's and 10's.

4. Count to 120, starting with any number less than 120, including 0 or 1.	4. Forward/Backward counting sequence to 100 and counting sequence by 2's, 5's and 10's
5. Read numerals to 120.	5. Quantities can be represented by numerals and number names.
6. Add within 20.	6. Part-part-whole reasoning, the commutative property of addition to add, and equivalence.
7. Add fluently within 10.	7. Part-part-whole reasoning, the commutative property of addition to add, and the ability to subitize arrangements to 5 items or up to 10 in a familiar arrangement (dominos, dice, ten frames).
8. Solve for an unknown in an addition equation involving 3 whole numbers (2 addends and a sum).	8. Part-part-whole reasoning, difference between addition and subtraction, and equivalence.
9. Solve addition story problems with sums to 20 involving situations of adding to and putting together, with unknowns in all positions.	9. Part-part-whole reasoning, equivalence, and write numbers to 20.
10. Use strategies to add sums to 20.	10. Part-part-whole reasoning, the commutative property of addition to add, equivalence, teen numbers are made up of a group of 10 and some ones and write numbers to 20.
11. Identify pennies and nickels by name and worth.	11. Different coins have specific names and values
12. Recognize, describe, extend, and create number patterns.	12. Forward/Backward counting sequence to 100 and counting sequence by 2's, 5's and 10's.
13. Organize, represent, and interpret data with up to three categories.	13. Data can be organized in graphs, charts, and tables, and tallies are used to represent quantities in data for efficient

	counting.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can tables and charts help us organize our thinking and interpret data? 2. How do we collect data? 3. How do we use counting to compare objects in a set? 4. How do we determine one more or one less than the number of objects in a set? 5. How can grouping objects make counting easier?	1. Important information can be found in representations of data such as tallies, tables and charts. 2. Questions can be answered by collecting and interpreting data. 3. Quantities can be compared using matching and words (greater than, less than, equal to). 4. Counting on and back from any number can determine one more/one less. 5. Counting by 2, 5 or 10 objects can make counting more efficient.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.b**: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making. ***When using Tech-Enhanced Activities (TEAs)**

Informational Texts:

- **Informational Books:**
  - Counting Books
  - How Big Is a Foot?
- **Media:**
  - Counting By 2's Song

Online Resources / Websites:
MLC Apps:

- Pattern Shapes App
- Number Frames App
- Number Rack App

Games:

- Gingerbread Game
- Tally Marks up to Ten
- Whack A Mole
- Bonds of Ten
- Ten Frames

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Add: to combine; to put together two or more quantities.
Attribute: a characteristic such as color, shape, size, etc.
Between: in the space separating two points, objects or numbers.
Circle: a two-dimensional (flat) shape made by drawing a curve that is always the same distance from a point called the center.
Compare: to examine in order to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Cone: a three-dimensional shape (solid) with a circular or elliptical base and a curved surface that tapers to the vertex.
Cube: a three-dimensional shape (solid) whose 6 faces are all squares.

Cylinder: a three-dimensional shape (solid) with one curved surface and two congruent flat ends that are circular or elliptical.
Dime: a U.S. coin worth ten cents or 1/10 of a dollar.
Edge: the line segment along which two faces of a three-dimensional shape (solid) meet.
Equation: a math statement asserting that two quantities have the same value.
Estimate: a close guess to the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs.
Face: a flat surface of a three-dimensional shape (solid).
Greater than: a symbol used to indicate that the number on the left is greater than the number on the right.
Hexagon: a two-dimensional (flat) shape with 6 sides.
Less: smaller in size, amount or degree.
Less than: a symbol used to indicate that the number on the left is less than the number on the right.
More: having a greater amount, quantity, degree or measure.
Ones: the numbers 0 to 9; also refers to the ones place.
Penny: a U.S. coin worth 1 cent or 1/100 of a dollar.
Pyramid: a three-dimensional shape (solid) that has a base with 3 or more sides and has triangular faces that meet at a point.
Rectangle: a two-dimensional shape (flat) with two pairs of parallel sides (4 total sides) and 4 right angles.
Rectangular Prism: a three-dimensional shape (solid) whose 6 faces are all rectangles.
Rhombus: a two-dimensional shape (flat) with 4 congruent sides.
Sphere: a three-dimensional shape (solid) constructed so that every point on the surface is the same distance from a point called the center.
Square: a two-dimensional shape (flat) with 4 congruent sides and 4 right angles.
Tens: the numbers 10 to 99; also refers to the tens place.
Three-dimensional (3-D) Shape: a solid shape with depth, weight and height; a shape that has volume.
Trapezoid: a two-dimensional shape (flat) with 4 sides and exactly one pair of parallel sides.
Triangle: a two-dimensional shape (flat) with 3 sides.
Triangular Prism: a three-dimensional shape (solid) with 2 triangular bases and 3 rectangular faces.
Two-dimensional (2-D) Shape: a flat shape with length and width; a shape with area, but not volume.
Vertex or Corner: the point at which the sides of a two-dimensional (flat) shape or the edges of a three-dimensional shape (solid) intersect.

Learning Plan

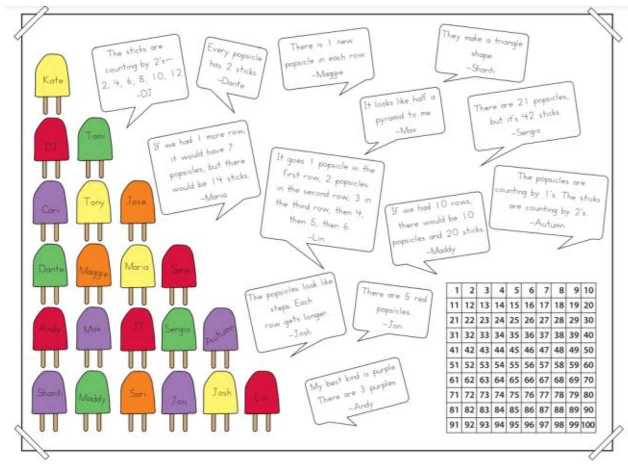
Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

As an entry point to the study of mathematics in first grade, Unit 1 works to establish classroom standards around exploring and communicating about numbers. Its mathematical focus is the development of number sense and number combinations (with emphasis on combinations to 10). The unit introduces important mathematical models, including the number rack and five- and ten-frames, and students are expected to become proficient using strategies that emerge from these models.

Week 1: The first module in Grade 1 is designed to jump-start students' mathematical thinking while orienting them to the routines, manipulatives, and work patterns they will encounter throughout the school year. Much of the content revolves around counting and organizing Popsicle sticks. Students practice counting forward and backward by 1s, 2s, and 5s on the number line and then explore simple counting patterns on a hundreds grid. They also express personal preferences as data on a chart and discuss patterns in the data.

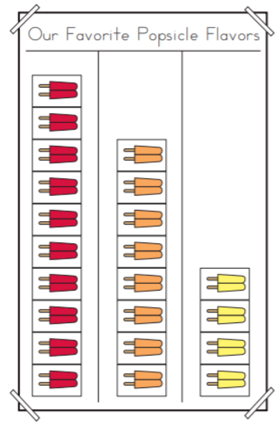
Co-construct popsicle chart:
Discuss patterns, number of pops, popsicle sticks, the correlation between the two numbers and make predictions about how many pops and sticks there will be in subsequent rows.

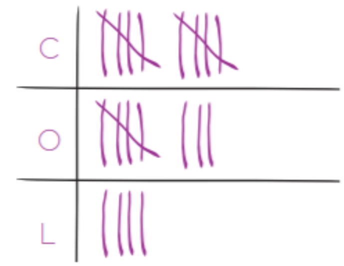


Create class graph and tally table of favorite popsicle flavors:

Pose each of the questions listed here. Have students share their answers in pairs first. Then take a little time with the whole group to share and discuss students' responses.

- Which flavor is most popular in our class? How do you know?
- Which flavor is least popular? How do you know?
- How many more votes did ________ get than ________? How did you figure it out?
- How many fewer votes did ________ get than ________? How did you figure it out?
- How many votes are there in all? How did you count them?
- Do you think the graph would turn out the same way in a different first grade classroom? Why or why not?

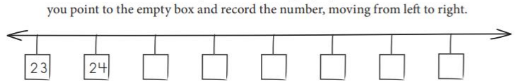




Practice counting sequence with number line model:

Count Forward

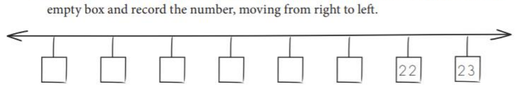
- Ask a student to pick a number between 20 and 40 to begin the count.
- Write that number in the first empty box on the far left of the number line.
- Have students choral count (count in unison), saying the number that comes next as you point to the empty box and record the number, moving from left to right.



- Continue until all the boxes on the number line are full.

Count Backward

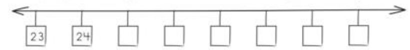
- Erase the numbers in the boxes and place the original beginning number in the last empty box on the far right of the number line.
- Have students choral count, saying the number that comes before as you point to the empty box and record the number, moving from right to left.



Week 2: The five sessions in this module are designed to solidify students' number sense to 10 and provide early work with facts to 10. Students explore number combinations for 5 and 10 in contexts that help them become familiar with fact families and also elicit higher forms of mathematical thinking. The module introduces two essential mathematical models: ten-frames and the number rack. These models support students to visualize numbers, number relationships, and number combinations. They also promote development of strategies that will eventually lead to mastery of basic addition and subtraction facts. The last session includes a quick assessment.

Count Forward

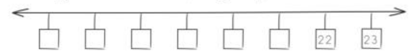
- Ask a student to pick a number between 20 and 40 to begin the count.
- Write that number in the first empty box on the far left of the number line.
- Have students choral count (count in unison), saying the number that comes next as you point to the empty box and record the number, moving from left to right.



- Continue until all the boxes on the number line are full.

Count Backward

- Erase the numbers in the boxes and place the original beginning number in the last empty box on the far right of the number line.
- Have students choral count, saying the number that comes before as you point to the empty box and record the number, moving from right to left.



Make and Record combinations for 5 and 10 using the math rack:

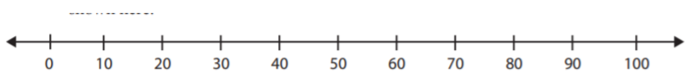
Create a chart on the board of the pairs of numbers that make 5, as shown here, to record students' suggestions. Continue until all six pairs are recorded.

Top Row	5	3	4	2	0	1
Bottom Row	0	2	1	3	5	4

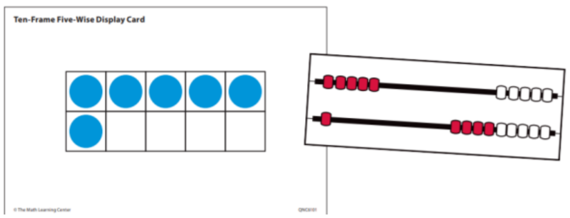
Write equations for 5 and 10 using math rack to solve and explain:

$$6 + \boxed{} = 10$$

Count forward/backward by multiples of 10 using number line support, cover different multiples to find "what's missing?":

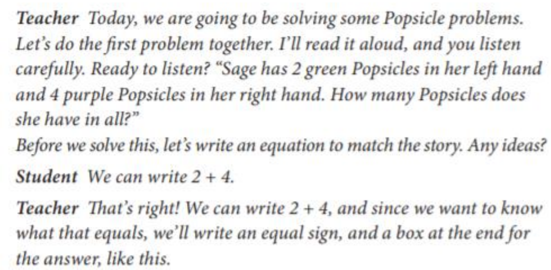


Quick flash 5 and 10 frame dot cards and have students subitize and build the number on their math racks (assess with quick count checkpoint):



Week 3: In this module students engage in “quick look” activities intended to help them subitize, or recognize the quantity of objects in a set without having to count each individually. Students also explore part-part-whole relationships with numbers to 20. These explorations include work with equations in which an unknown variable might be in any one of three positions. The last session introduces length measurement with nonstandard units.

Solve and record equations with result unknown, change unknown and start unknown for popsicle story problems using math rack encouraging and discussing different strategies (count by 1s, use a double and count on, use 5 as a landmark):



Teacher *Today, we are going to be solving some Popsicle problems. Let's do the first problem together. I'll read it aloud, and you listen carefully. Ready to listen? "Sage has 2 green Popsicles in her left hand and 4 purple Popsicles in her right hand. How many Popsicles does she have in all?"*
Before we solve this, let's write an equation to match the story. Any ideas?

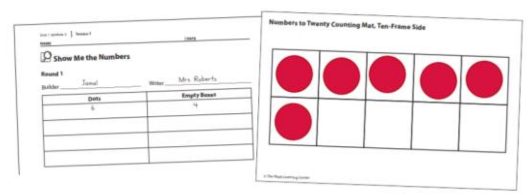
Student *We can write 2 + 4.*

Teacher *That's right! We can write 2 + 4, and since we want to know what that equals, we'll write an equal sign, and a box at the end for the answer, like this.*

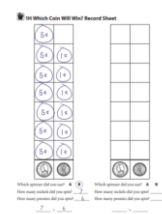
Model and practice hopping forward/backward on the open number line by 10s:

- Place your pen on the 0 at the board, and make a hop by drawing an arc above the line for each multiple of 10 as you and the students slowly count by 10s up to 100 together.

Build numbers 0-10 on ten-frames and find the number to “make 10”:



Practice penny/nickel identification and counting by 5s and 1s with “Which coin will win? spinner and recording sheet:

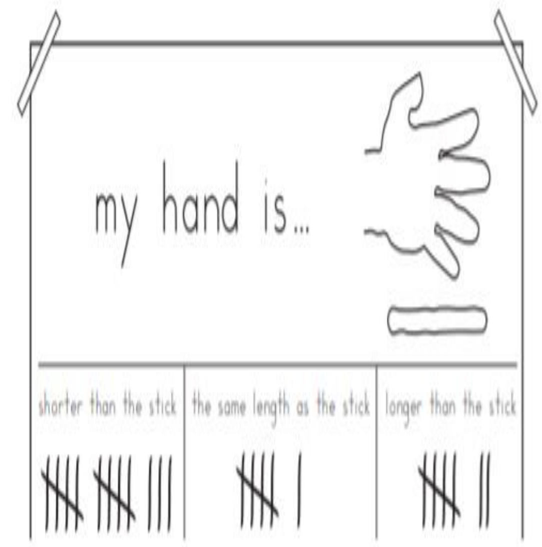


Extend to quick look work with math rack to teen numbers (ten and more**):**

Once students seem to be having success with numbers in the range of 0–10, transition to using both rows of beads on the number rack as you continue to play Quick! Look! with the class.

- Display the following numbers: 10, 15, 19, 16, 20, 13, 18, 12, 11, 17
- Probe for student strategies, and highlight and encourage the strategies of anchoring on 5 and 10.

Compare length of hand to popsicle sticks and create frequency chart using tallies:

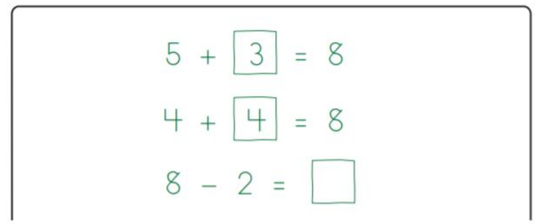


Week 4: The number rack explorations in this module involve part-part-whole relationships, particularly missing-addend and subtraction problems. Students also engage in "quick look" activities to help them subitize quantities to 20, and they add 1 and subtract 1 from those totals. Finally, students revisit the use of nonstandard units (Popsicle sticks, Unifix cubes, heel-to-toe steps) to measure the lengths of various objects and distances. The final session features a post-unit assessment.

Practice building numbers on the math rack with an unknown part, changing the known part to make numbers 5-10 (and into teens for a challenge**) in different ways; write corresponding addition and subtraction equations:**

Student *I put 2 on the top row.*

Teacher *Hmm… Let me think about this one. I know that we are trying to make 8 in all. And I know that you put 2 on the top row. So, if I took 2 away from the 8, then I would know how many there are on the bottom row.*



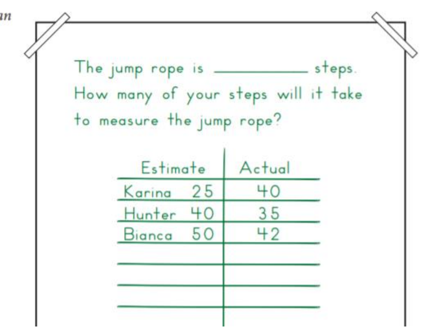
Teacher *Let's see… 8 subtract 2. Start at 8, and then take away… 7, 6. Six! You had six on the bottom row, right?*

Measure students with unifix cubes; estimate more or less than popsicle sticks used in earlier activity; estimate total, use 10 cubes as a benchmark and re-estimate and eliminate estimates too low/high, measure a student modeling end-to-end with no gaps/overlaps, count by tens and ones

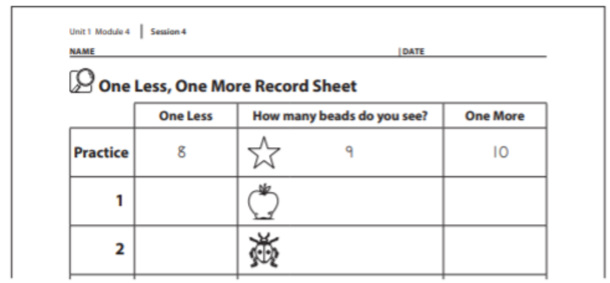
Teacher *Before we count the cubes, let's look at the chart again. Do you think there are any estimates that are way too big or way too small? If you do, we'll cross them out.*

Students *I think it's more than 21 or 25.*
I don't think it's 300. 300 is a really big number. I don't think even the teacher is that big.
I think 236 is too big.
I agree with you. That train is smaller than

Measure jump rope using teacher then student steps; record estimates and actual length eliminating estimates too high/low mid-way through the length of the rope



Co-construct closed number line 0-50 counting forward and backward by 5s:
Ask adding/subtracting questions using the number line:
"If I am at 20 what is 5 more?"
"What is 5 less than 30?"
"What is 3 jumps of 5?"
"So if I start at 20 and add 15 (3 jumps of 5) where will I land?"


Unit 1 Module 4 | Session 4

NAME | DATE

One Less, One More Record Sheet

	One Less	How many beads do you see?	One More
Practice	8	9	10
1			
2			

Practice subitizing using the structure of the math rack and numbers one more/one less with game "Quick Looks Plus One, Minus One"

Unit 1 Group Assessment:

- Make 5 and 10 on math rack
- Subitize and replicate numbers on a ten-frame
- Find missing numbers on a closed number line

Interdisciplinary / Real World / Global Connections

- Addition helps kids master the relationships between numbers and understand how quantities relate to one another.
- Students will use adding when they are counting their money or counting other things like pencils, books, flowers, make up, dresses, shoes, and more.
- We see whole numbers on nutrition labels, or signs on the highway telling us how many miles are to the next exit/city.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively
☐ Writing effectively for a variety of purposes
☐ Presenting ideas accurately with the support of engaging media
☒ Thinking critically to solve problems and reach well-reasoned judgments
☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play.
- See "Game Variations" in workplace guides.
- See "Assessment and Differentiation" in workplace teacher masters.

Support:

- When applicable, give students smaller numbers/smaller amounts of objects to practice the strategies.
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall.
- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation.
- See "Game Variations" in workplace guides.
- See "Assessment and Differentiation" in workplace teacher masters.

English Language Learners (ELL):

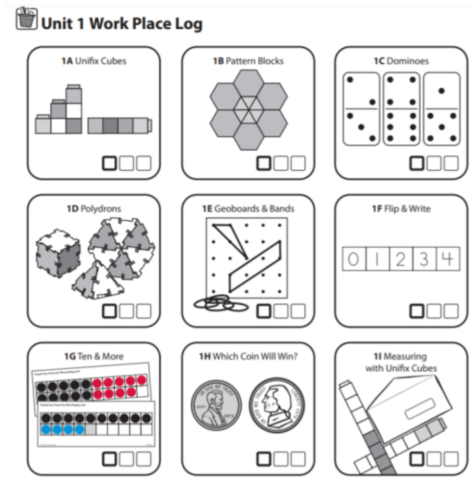
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves.
- Have pairs of ELL students sit with another pair of students as they play in a work place so that other students can offer step-by-step instructions while they play.
- Use workplace sentence frames to support student discourse using math vocabulary.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Quick Count Checkpoint
- Unit 1 Post-Assessment

Quick Count Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name			
1 Briefly view an arrangement of beads on the number rack and then draw dots on a ten-frame to show the total and the arrangement. *3 total, 3 top row, 0 bottom row*	Supports K.CC 1.OA.6	**2 pts.** 1 pt. for the correct total 1 pt. for drawing the dots in the same formation as the beads on the rack				
2 Briefly view an arrangement of beads on the number rack and then draw dots on a ten-frame to show the total and the arrangement. *6 total, 5 top row, 1 bottom row*	Supports K.CC 1.OA.6	**2 pts.** 1 pt. for the correct total 1 pt. for drawing the dots in the same formation as the beads on the rack				
3 Briefly view an arrangement of beads on the number rack and then draw dots on a ten-frame to show the total and the arrangement. *10 total, 5 top row, 5 bottom row*	Supports K.CC 1.OA.6	**2 pts.** 1 pt. for the correct total 1 pt. for drawing the dots in the same formation as the beads on the rack				
4 Briefly view an arrangement of beads on the number rack and then draw dots on a ten-frame to show the total and the arrangement. *9 total, 5 top row, 4 bottom row*	Supports K.CC 1.OA.6	**2 pts.** 1 pt. for the correct total 1 pt. for drawing the dots in the same formation as the beads on the rack				
5 Briefly view an arrangement of beads on the number rack and then draw dots on a ten-frame to show the total and the arrangement. *5 total, 5 top row, 0 bottom row*	Supports K.CC 1.OA.6	**2 pts.** 1 pt. for the correct total 1 pt. for drawing the dots in the same formation as the beads on the rack				
TOTAL SCORE/LEVEL OF PROFICIENCY*		**10 pts.**				

* **3–10 points:** Working at Tier 1 or Tier 2 Level
2 points or fewer: May need Tier 3 Support

Unit 1 Group Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name				
1a Show two ways to make 5 using the top and bottom row of beads on a number rack. *Answers vary: 2 + 3, 4 + 1, 5 + 0, etc.*	1.OA.5 1.OA.6	**2 pts.**					
1b Show two ways to make 10 using the top and bottom row of beads on a number rack. *Answers vary: 1 + 9, 2 + 8, 3 + 7, etc.*	1.OA.6	**2 pts.**					
2 Briefly view an arrangement of dots on ten-frames and then place markers on another ten-frame to replicate the arrangement. *5 top, 0 bottom* *5 top, 3 bottom* *4 top, 4 bottom* *4 top, 3 bottom*	Supports K.CC 1.OA.6	**4 pts.**					
3 Fill in the missing numbers on the number line. *a – 5, 9; b – 13, 16; c – 8, 12; d – 50*	1.NBT.1	**7 pts.**					
TOTAL SCORE/LEVEL OF PROFICIENCY*		**15 pts.**					

* **Meeting Standard** 12–15 points (75%–100% correct)
Approaching Standard 8–11 points (50–74% correct)
Strategic 4–7 points (25–49% correct)
Intensive 3 points or fewer (24% or fewer correct)

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 2: Developing Strategies with Dice and Dominoes
Pacing	4 weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. **Reason abstractly and quantitatively.**
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
1.OA.1 Solve addition story problems with sums to 20 involving situations of adding to and putting together, with unknowns in all positions
1.OA.1 Solve subtraction story problems with minuends to 20 involving situations of taking from, taking apart, and comparing, with

unknowns in all positions
1.OA.3 Apply the commutative property of addition to add
1.OA.4 Solve subtraction problems by finding an unknown addend
1.OA.5 Solve addition and subtraction problems by counting on and counting back
1.OA.6 Add and subtract fluently within 10
1.OA.6 Use strategies to add and subtract with sums and minuends to 20
1.OA.6 Use the relationship between addition and subtraction to add and subtract within 20
1.OA.7 Demonstrate an understanding that the equal sign indicates equivalence
1.OA.8 Solve for the unknown in an addition or subtraction equation involving 3 whole numbers
1.NBT.3 Compare pairs of 2-digit numbers
1.NBT.3 Use >, =, and < symbols to record comparisons of two 2-digit numbers
1.MD.4 Organize, represent, and interpret data with up to 3 categories

Supporting Standards:

1.OA Recognize number patterns
1.NBT Count by 5s and 10s to 100

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Subitize the number of objects in a collection smaller than 6.	1. Familiar patterns and arrangements of dominoes and dice.
2. Solve addition problems by counting on.	2. There is a connection between addition and counting; adding 2 is the same as counting on two.
	3. Part-part-whole reasoning, the commutative property of

3. Add within 20.

4. Determine if one quantity is greater than, less than or equal to another quantity.

5. Count and read numbers to 120.

6. Use strategies to add sums to 20.

7. Solve addition equations with the unknown in all positions.

8. Use >, <, = symbols to compare numbers.

9. Apply the commutative property of addition to add.

10. Solve subtraction problems by finding an unknown addend.

addition to add, and equivalence.

4. Numbers in our counting sequence increase in value as we count forward and decrease in value as we count backwards.

5. Quantities can be represented by numerals and number names.

6. Addition facts can be solved in different ways including making 10, counting on, and doubles.

7. The equal sign is a symbol for equivalence.

8. The meaning of mathematical symbols for comparison and equality.

9. Whole numbers can be added in any order and the sum will remain the same.

10. Subtraction is the inverse operation of addition.

11. Addition and subtraction are inverse operations.

12. Addition is a commutative property; subtraction is not commutative.

11. Use the relationship between addition and subtraction to add and subtract within 10.	13. Backward counting sequence within 20.
12. Solve for the unknown in an addition or subtraction problem involving 3 whole numbers.	14. Data can be organized in graphs, charts, and tables, and tallies are used to represent quantities in data for efficient counting.
13. Solve subtraction problems by counting back.	15. Forward/Backward counting sequence to 100 and counting sequences by 5's and 10's.
14. Organize and interpret data with up to 3 categories.	16. Shapes can be partitioned into fractional pieces by dividing it into equal parts of the whole.
15. Count by 5s and 10s.	17. Different coins have specific names and values.
16. Partition a rectangle into halves and fourths/quarters.	
17. Determine the value of a collection of coins less than $1.00.	

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What happens when we join two (or more) quantities?	1. Addition is the action of joining two or more whole numbers to get a new total (sum).

2. How can we solve addition problems in different ways?	2. By comparing a variety of solution strategies, students build a stronger understanding of addition and subtraction and their connection to one another.
3. What happens when we change the order of numbers in an equation? Is the result always the same?	3. Operations have properties that will always determine how we calculate a solution to an equation.
4. In what ways are addition and subtraction alike and different?	4. Fact families reveal the relationships between addition and subtraction. Inverse operations connect addition and subtraction facts to each other, but the properties of addition and subtraction help us define the ways they are different.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

Standard 1.5.b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

***When using Tech-Enhanced Activities (TEAs)**

Informational Texts:

- **Informational Books:**
  - Domino Addition
  - 26 Letters and 99 Cents
  - Arctic Fives Arrive
  - The Coin Counting Book
- **Media:**
  - Song: Counting with a Leprechaun

- Song: Show me the Money

Online Resources / Websites:

MLC Apps:
- Number Rack

Games:
- Bonds of Ten
- Addition with Manipulatives
- Okta's Rescue

Apps:
- Number Flash

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Add: to combine; to put together two or more quantities.
Cent (¢): monetary unit equal to 1/100 of a dollar.
Column: a vertical arrangement or list of objects or numbers.
Compare: to examine in order to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Dime: a U.S. coin worth ten cents or 1/10 of a dollar.
Equal: of the same amount or value.
Equation: a math statement asserting that two quantities have the same value.
Even Number: a number that can be exactly divided by 2; all even numbers end with 0, 2, 4, 6 or 8.
Fact Family: a set of equations that relate addition and subtraction (or multiplication and division); said to be a family because each equation uses the same numbers.

Fourth: one part when a number, shape or set is divided into exactly 4 equal parts; also called a quarter.
Greater than: a symbol used to indicate that the number on the left is greater than the number on the right.
Half: one part when a number, shape or set is divided into exactly 2 equal parts.
Less than: a symbol used to indicate that the number on the left is less than the number on the right.
Nickel: a U.S. coin worth 5 cents or 1/20 of a dollar; 20 nickels are equal in value to 1 dollar.
Odd number: a number that cannot be evenly divided by 2; odd numbers end in 1, 3, 5, 7 or 9.
Pattern: a collection of numbers, shapes or objects that forms a consistent or characteristic arrangement.
Penny: a U.S. coin worth 1 cent or 1/100 of a dollar.
Row: a horizontal arrangement or list of objects or numbers.
Square: a two-dimensional shape (flat) with 4 congruent sides and 4 right angles.
Subtract: to take one quantity away from another or find the difference between two quantities.
Sum or total: the result of adding two or more numbers.
Triangle: a two-dimensional shape (flat) with 3 sides.

Learning Plan

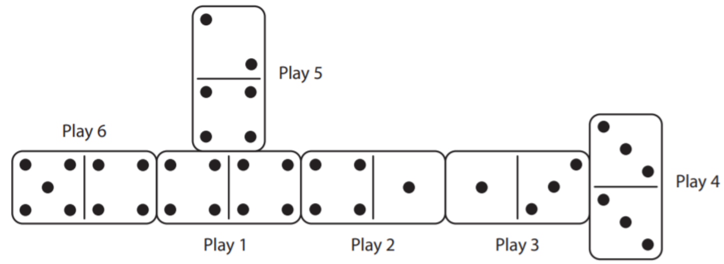
Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

This unit features dominoes, dot cards, and the number rack to help children develop confidence with efficient, effective, and sensible strategies for adding and subtracting single-digit numbers. The work takes advantage of students' ability to subitize (recognize the quantity represented in a set without having to count each individual object in the set) on common dot arrangements such as those found on dominoes or dice. Students explore such strategies as counting on, combining small groups of numbers within larger numbers, building from known facts, using doubles facts to solve other addition problems, counting by 5s and 10s, and using the commutative property. Students are encouraged to view the equal sign as a way to indicate that two expressions are of equal value, not as a symbol that precedes "the answer." This relational view of equality is perhaps the most important algebraic concept to be learned in the early grades, making it possible for young children to solve for unknown values in an equation.

Week One: Week 1 focuses on developing counting and addition skills, using dominoes as a springboard. Students learn games in which they match the dots on dominoes, count or add the dots on the two halves of a domino, and write equations and inequality statements for the amounts. They also share and discuss addition strategies beyond counting by 1s, such as counting on, combining small groups, and working from known facts to those less familiar. Two new Work Places are introduced, and two Home Connections are assigned.

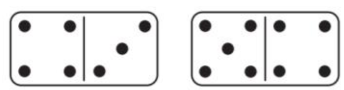
Read *Domino Addition* and play dominoes in pairs stressing the ideas of matching the dots, instantly recognizing the number of dots in a small set and recognizing doubles.



Practice subitizing and counting strategies to add with *Domino Top Draw*:

Players turn a set of dominoes face-down and mix them up. Then they take turns drawing one domino each and figuring out how many dots they have. They compare numbers, and the player with the greater number gets to take both dominoes. When all the dominoes are gone, each player counts his or hers The player with the most dominoes wins the game.

Practice subitizing, addition strategies and comparing whole numbers with *Domino Add & Compare:*

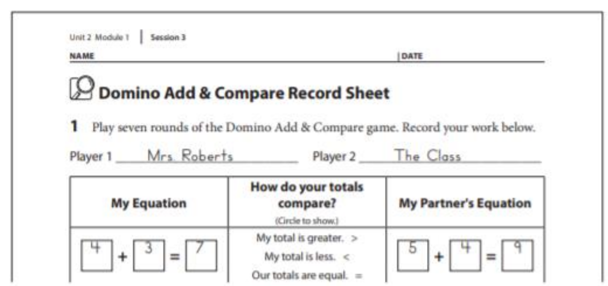


Teacher *Who would like to share how many dots there are total on the domino I picked—the one with 4 and 3?*

Students *It's 7, 'cause I went 4… 5, 6, 7.*
I think she's right—I got 7 because it's like 3 and 3, and then 1 more, and that makes 7.
I went 4 and 4 is 8, and then take away 1, so it makes 7.

Teacher *What did you all get for the total number of dots on your domino—the one with 5 dots on one-half, and 4 on the other?*

Students *I know 4 and 4 is 8, and then 1 more is 9.*
I just counted all the dots real fast. It was 9!
I went 5, and then 6, 7, 8, 9.



Unit 2 Module 1 | Session 3

NAME | DATE

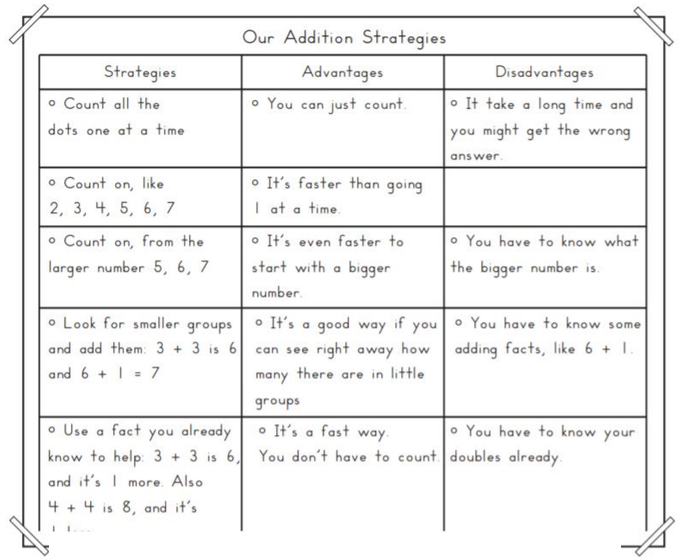
Domino Add & Compare Record Sheet

1 Play seven rounds of the Domino Add & Compare game. Record your work below.

Player 1 Mrs. Roberts Player 2 The Class

My Equation	How do your totals compare? (Circle to show.)	My Partner's Equation
4 + 3 = 7	My total is greater. > My total is less. < Our totals are equal. =	5 + 4 = 9

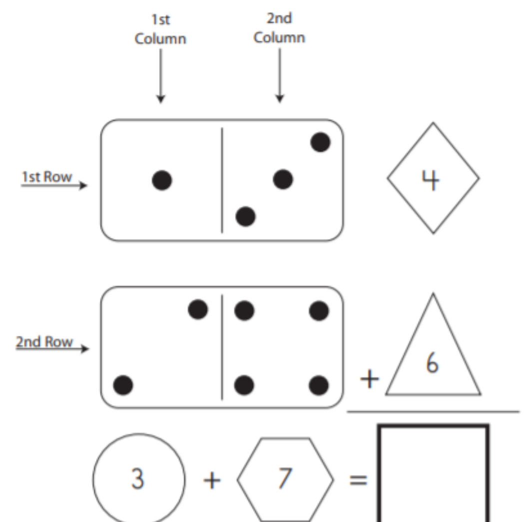
Co-construct class *Addition Strategies* chart:
Carefully select dominoes (6,1; 3,4; 5,2) to lead students to certain strategies. Discuss why some strategies are better for certain numbers than others. Use this anchor chart as reference moving forward.



Our Addition Strategies

Strategies	Advantages	Disadvantages
◦ Count all the dots one at a time	◦ You can just count.	◦ It take a long time and you might get the wrong answer.
◦ Count on, like 2, 3, 4, 5, 6, 7	◦ It's faster than going 1 at a time.	
◦ Count on, from the larger number 5, 6, 7	◦ It's even faster to start with a bigger number.	◦ You have to know what the bigger number is.
◦ Look for smaller groups and add them: 3 + 3 is 6 and 6 + 1 = 7	◦ It's a good way if you can see right away how many there are in little groups	◦ You have to know some adding facts, like 6 + 1.
◦ Use a fact you already know to help: 3 + 3 is 6, and it's 1 more. Also 4 + 4 is 8, and it's	◦ It's a fast way. You don't have to count.	◦ You have to know your doubles already.

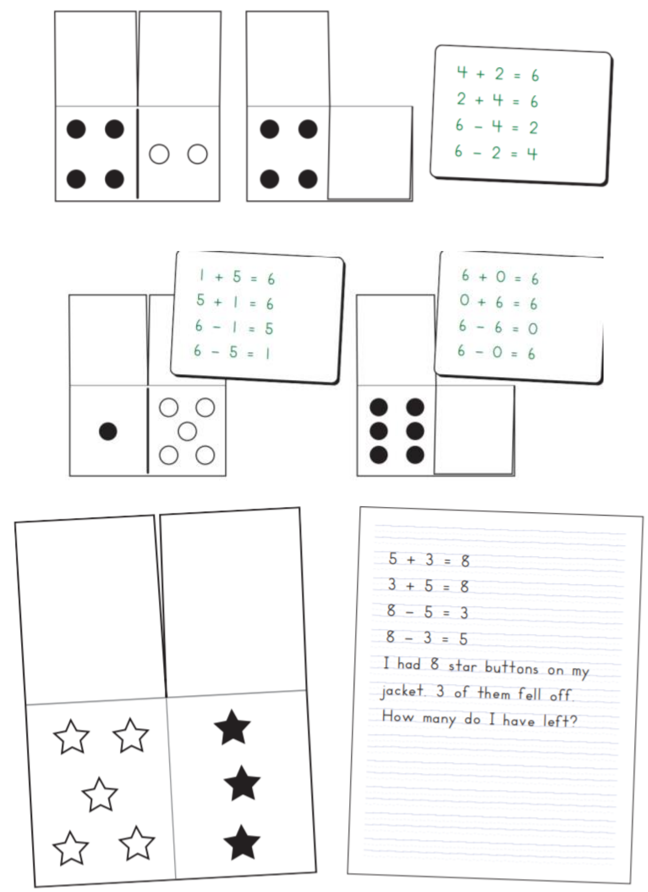
Model and solve *Magic Square* domino puzzles:
Use 2 dominoes placed horizontally one above the other. Add two columns of pips and two rows. Finally add the result of 2 rows and 2 columns. Look for patterns (sum is always the same) and discuss if this is magic or if there is a mathematical reason.



Week Two: This week maintains a focus on addition and subtraction strategies and emphasizes solving for an unknown. Students use and make double-flap cards to discover the relationships between addition and subtraction, to further explore the commutative property, and to learn to solve for an unknown in any position. They generate equation fact families and story problems. The idea that the equal sign describes a relationship between two quantities that have the same value, rather than indicating "the answer," is reinforced. One new Work Place and two Home Connections are introduced. The week concludes with an addition checkpoint.

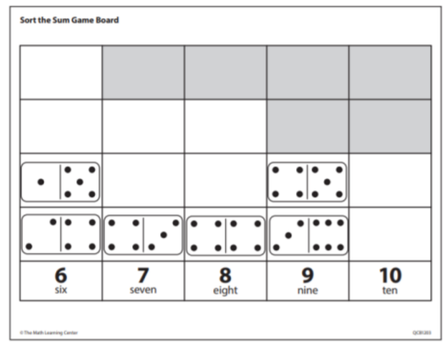
Number recognition and counting fluency practice:
Complete at the beginning of each day with different number ranges. Write the number 30 on the board. Ask students to whisper the number name to a partner. Have the class say the number aloud. Ask what number comes after (what is one more than) 30. Class will count by 1s until they get to 50.

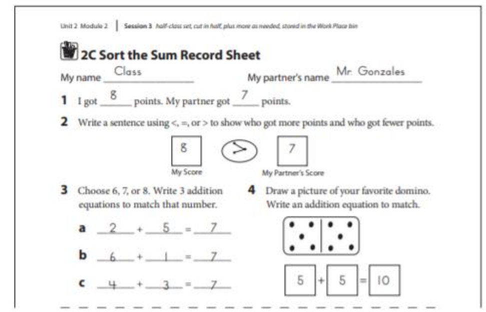
Use double-flap cards to introduce addition/subtraction fact families:
Model with double-flap cards to represent an unknown in all positions. Write corresponding equations. Work through a card until all equations are recorded. Let students notice the similarities between the 4 equations. Students make their own dot cards and record the fact families.



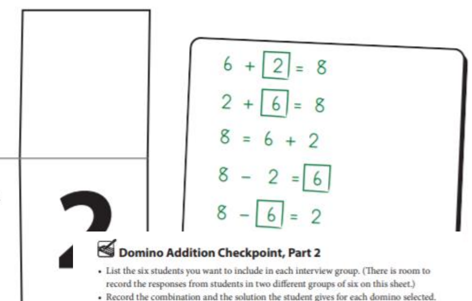
Co-create a double-flap picture card, writing equations and story problems:
Show students the back of a new card with the number 7. Have students generate possible numbers under each of the flaps. Reveal one of the flaps and have students determine what has to be under the other flap. Write 2 addition equations that match the card. Write a story problem and have students determine which of the equations matches the story. Repeat with different numbers and pictures. Have students make their own picture cards and write a story problem to match.

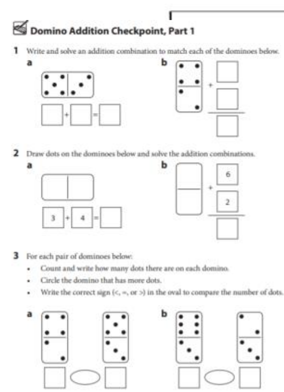
Play *Sort the Sum* with dominoes to see how whole numbers can be composed in different ways, practice writing equations, addition strategies and comparing whole numbers.

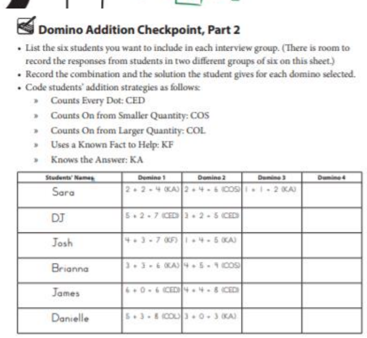




Introduce double-flap cards with numbers to move from pictorial representation of quantities to abstract.
Write equations with a square in the place of the unknown in all positions.







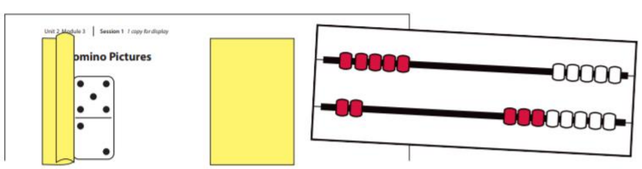
Assess students' understanding of writing and solving addition equations:
Complete written part 1 of assessment with the whole class. Read

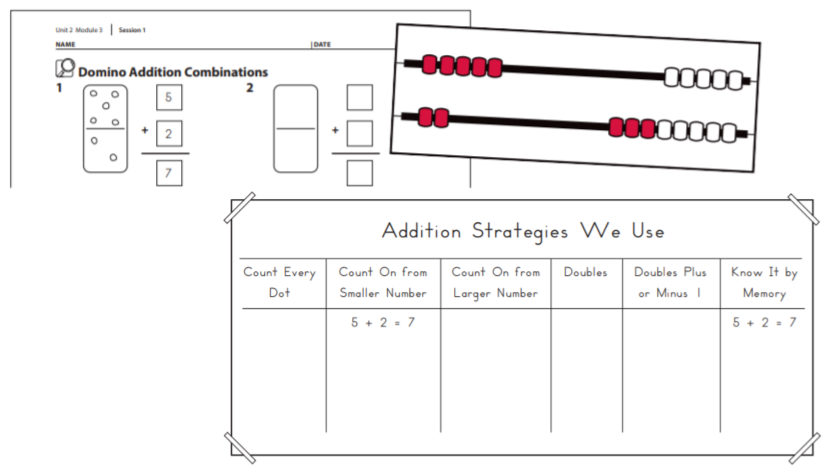
directions aloud and provide practice problems before beginning. While students play workplaces, meet with small groups of students to administer part 2, recording student responses for each domino. Each student selects a domino, discusses sum and strategy for adding and places domino on the correct column of pre-made addition strategies chart.

Week Three: The focus of week 3 is on developing addition and subtraction strategies, particularly doubling, counting on, and counting back to solve combinations within 12. Students work with the number rack and then learn games in which they add, subtract, and record their results on graphs. Students who are still counting by 1s to add and subtract are encouraged to count on and count back instead, and those who have moved beyond counting by 1s are encouraged to develop strategies that make use of well-known facts to solve fewer familiar combinations. Three new Work Places are introduced. The week ends with a unit assessment.

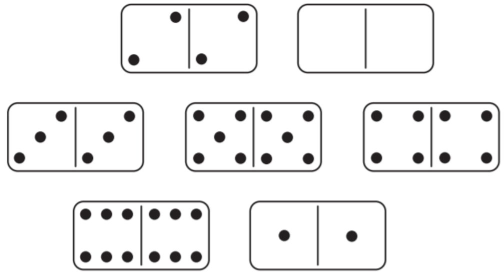
Number recognition and counting fluency practice:
Complete at the beginning of each day with different number ranges. Write the number 37 on the board. Ask students to whisper the number name to a partner. Have the class say the number aloud. Ask what number comes after (what is one more than) 30. Class will count by 1s until they get to 57.

Play domino quick flash (subitizing and combining amounts less than 4), build domino amounts using top and bottom rows of math rack and write matching equations (vertically) to tell how many in all:
Reveal top and bottom of a domino one at a time asking students to build the number of dots on the top of the math rack, then repeat with the bottom half of the domino. Students build this amount on the bottom row. Share strategies for finding total/sum and record on an *Addition Strategies* class anchor chart.





Observe and discuss double dominoes:

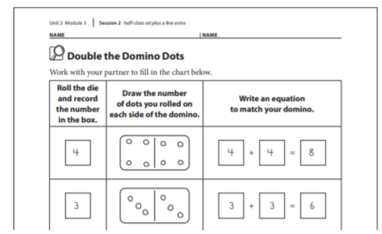


Once students have had a chance to share, press their thinking with some additional questions:

- What is the highest total in the collection? (12) What is the lowest total in the collection? (0)
- What is alike about all of these dominoes? What is different? (Students' comments might include the fact that all of the dominoes are doubles, they're all even numbers, they all have matching sides, you can split them all in half, and so on.)
- Do these dominoes show odd or even numbers? (Even) How do you know? (Students' explanations will vary, but likely someone will mention the fact that on all the dominoes, every dot has a partner.)

Use dice to draw double dominos and record addition double equations:

- Player A rolls the die and records the number in the first column.
- Player B draws that number of dots on the left side of the blank domino.
- Player A draws the same number of dots on the right side of the domino.
- Player B writes an equation in the last column to match the domino.
- Students take turns being Player A and B, so they switch jobs each row.

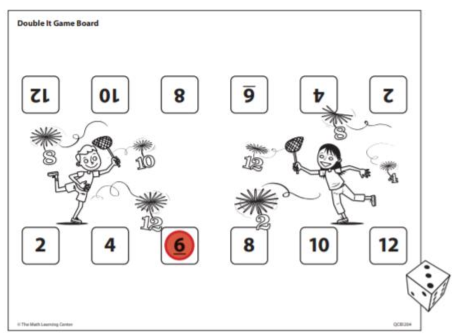


Double the Domino Dots

Work with your partner to fill in the chart below.

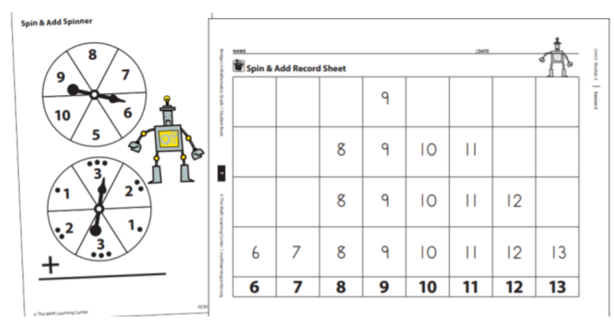
Roll the die and record the number in the box.	Draw the number of dots you rolled on each side of the domino.	Write an equation to match your domino.
4		4 + 4 = 8
3		3 + 3 = 6

Play partner workplace *Double It*:



I got 3! Three and 3 is 6, so I get to cover the 6 on my side of the board.

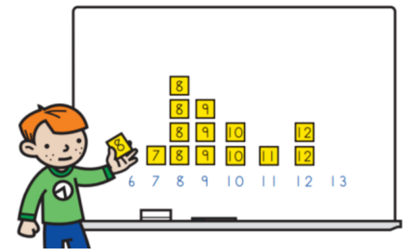
Practice addition facts and counting on strategy with *Spin and Add*:



Give students the chance to make observations and predictions about the game based on their first look at the game board and spinner. After playing the game make a class chart of the number that won- the column was filled first. Create a class frequency chart and discuss probing questions.

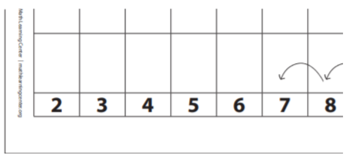
- What do students notice about the data?
- Did some numbers come up as first-place winners more often than others?
- Which number came up as the winner most often?
- Were there some numbers that didn't come up at all? What were they?
- Would you get the very same results if everyone played the game again? Why or why not?
- Why are some numbers more likely to win than others?

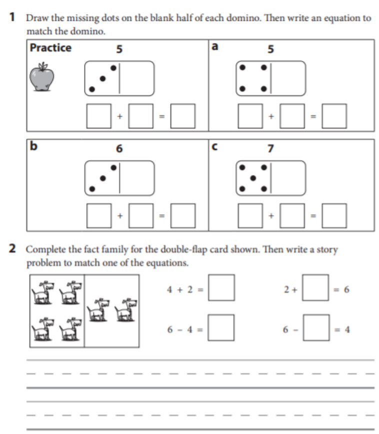
As they finish, give each pair a 3″ sticky note on which to write their winning number, and have them post it above the corresponding number on the board.

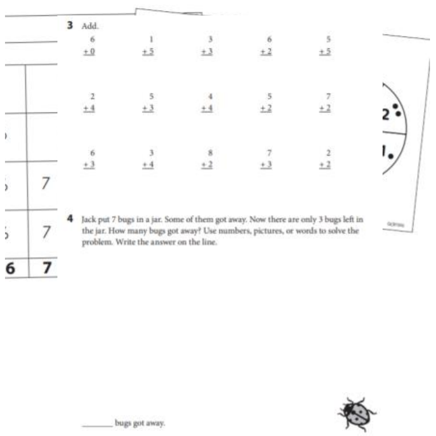


Practice subtraction facts and counting back strategy with *Spin and Subtract*:
Give students the chance to make observations and predictions about the game based on their first look at the game board and spinner. Encourage students to use the "number path" at the bottom of the game board to help with counting back.

Explain that counting backward is one way to sub know the answer and there isn't an easier way. Th when subtracting small amounts like 1, 2, and 3. the bottom of the record sheet to demonstrate the backward several times.

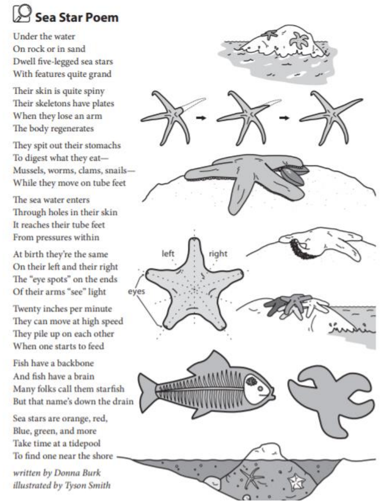






Administer Unit 2 Assessment:
Complete practice problems and review together. Read directions aloud and allow students to work independently.

Week Four: The focus of week 4 is on counting by 5s and 10s to become more efficient at counting amounts larger than 10. Three of the sessions use five-armed sea stars as a context for counting, and students work together to make a quilt that exemplifies the counting-by-5s pattern in a variety of ways. Making the quilt blocks also involves some work with shapes and fractional pieces. The last two sessions introduce games that feature pennies, nickels, and dimes—another good context for counting by 5s and 10s, as well as reinforcing the counting on strategy. The games also give students practice counting collections of coins and comparing two-digit numbers.

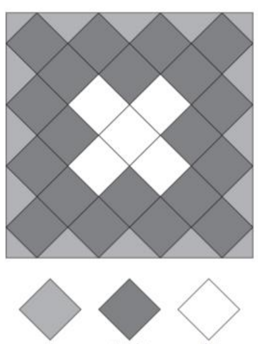


Play *I Have, You Need* as warm up this week. Choose a different target number, starting with 5:

Hold up 3 fingers. Ask students how many they need to make the target number. Repeat with a different number of fingers to review the combinations of the target number. Allow students to use math racks as needed.

Construct class quilt squares (3 days):

Read *Sea Star Poem*. Each student will make a sea star square and a patchwork block for the class quilt. Students will need to partition squares in halves to make triangles and partition those triangles in half to make smaller triangles. Students should discuss observations before constructing and again when the squares are assembled into the class quilt. Assemble the first row of the quilt. Ask students to make predictions and observations. Record student observations.

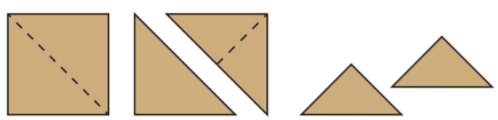


Teacher *How many triangles will I get if I cut this square in half diagonally?*

Students *You'll get 2.*

Teacher *You're right, I did get 2 halves when I cut. These seem to fit the bigger triangles on my quilt block pattern exactly, but they're too big for the corner triangles. What can I do to make them the right size?*

Students *Cut that triangle in half again. See if that works.*



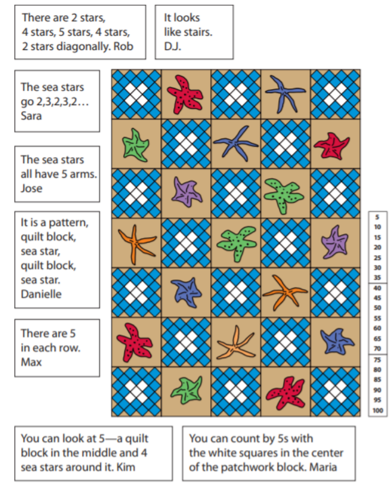
Teacher *It works! The small triangles fit into the corners exactly. So we need some squares cut in half and one cut in fourths. So how many squares of tan do you need for this job?*

Students *If we keep the pattern going, a sea star will come next. Patchwork, sea star, patchwork, sea star, patchwork, sea star. It'll be a sea star in the next row!*
It looks like the pattern will go down, too.

Teacher *How many rows of 5 do you think we'll be able to make with your quilt blocks?*

Students *Five rows 'cause we're doing 5s!*
We all have two quilt blocks, so maybe 10.
If you count our blocks by 2s, you get something bigger than 20, but I don't know how many rows that is.

Use completed quilt to count by 5s and discuss patterns:
Discuss sea stars in the quilt and how we could best count the number of arms. Using guiding questions to prompt discussion. Use students' hands to make the connection between the sea stars arms and counting by 5s. Have students find multiples of 5 on a hundreds chart, circling the numbers we say when we count by 5s.



Here are some other questions you might ask to help students establish connections between the sea stars on the quilt and the Counting by Fives Strip.

- How many sea star arms do you see in the top row? (10) What about the second row? (15)
- How many sea star arms do you see in the top two rows together? (25)
- How many sea star arms are there on the whole quilt? (85 on the quilt shown, but the total will depend on your class size)
- Can anyone figure out how many sea stars there would be if they could see 10 arms? (2) 25 arms? (5) How are you figuring it out?

Unit 2 Module 4 | Session 3

NAME | DATE

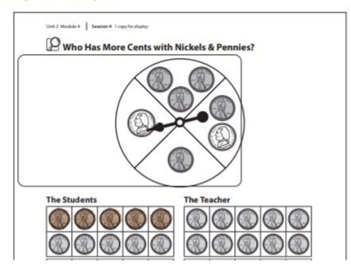
Counting to One Hundred Chart

Circle the counting-by-5s numbers on your chart, then color them in. What do you notice about this counting pattern?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

Students *5, 10, 15, 20, 25, 30, 35—this is easy!*
They just go under each other—all the 5s, and all the 10s.
I'm getting ones with 5s all in the same row, and ones with 10s.
I got 1, 2, 3, 4, circle! 1, 2, 3, 4, circle! It's a pattern.

Practice counting by 5s in a new context with *Who Has More Cents with Nickels and Pennies?*:
Review nickels and pennies: names, value and coin features. Have students make observations about the new game board and spinner. Ask how many pennies there are in all (40) and how students can accurately count them (by 1s, 5s, or 10s given the ten-frame structure). When one player wins, encourage students to discuss and write inequalities (32 cents < 40 cents) to explain who won or lost. Lead the closing discussion with the



- Have students color that many pennies on their record sheets (with brown crayon), while you color in the same number on the students' side of the Who Has More Cents with Nickels & Pennies? Teacher Master.
- Show students how to draw a vertical line after the last penny to show where they stopped and where they need to pick up counting and coloring in pennies on their next turn.

following questions:

- What would you rather have, a penny or a nickel? Why?
- Is 4¢ more or less than a nickel?
- Is 8¢ more or less than a nickel?
- How much money would you have with a nickel and 2 pennies?

CHALLENGE

  - » How many nickels could you get for 10 pennies?
  - » How much are 3 nickels worth?

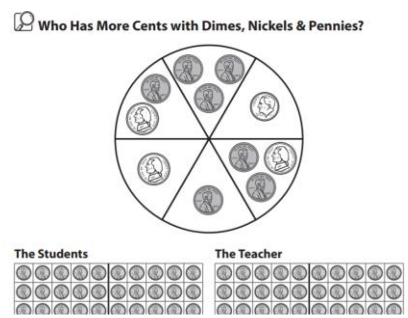
- Tell students you will play a new version of this game in the next session.

Practice counting by 5s in a new context with *Who Has More Cents with Dimes, Nickels and Pennies?*
Have students share observations about the new spinner. How is it the same/different from the last spinner? Explain the new target is 100 cents. When someone reaches exactly 100 cents, have students write two inequality statements for their partners' final amounts (87 cents <100 cents and 100 cents > 87 cents). Lead closing discussion with the following questions:

- What would you rather have, a penny, a nickel, or a dime? Why?
- Is 9¢ more or less than a dime?
- Is 12¢ more or less than a dime?
- How many nickels could you get for a dime?

CHALLENGE

  - » How much money would you have with a nickel and 2 dimes?
  - » How much are three dimes worth?
  - » Would you rather have 6 nickels or 4 dimes? Why?
  - » Would you rather have 10 nickels or 5 dimes? Why?



Interdisciplinary / Real World / Global Connections

- Sea stars' context provides students with the opportunity to see patterns and numbers as they occur in nature.

- Students use coins to practice counting by groups of different sizes (unitizing) in a real-world context.
- Addition helps kids master the relationships between numbers and understand how quantities relate to one another.
- Students will use adding when they are counting their money or counting other things like pencils, books, flowers, make up, dresses, shoes, and more.
- We see whole numbers on nutrition labels, or signs on the highway telling us how many miles are to the next exit/city.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively
☐ Writing effectively for a variety of purposes
☐ Presenting ideas accurately with the support of engaging media
☒ Thinking critically to solve problems and reach well-reasoned judgments
☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

English Language Learners (ELL):

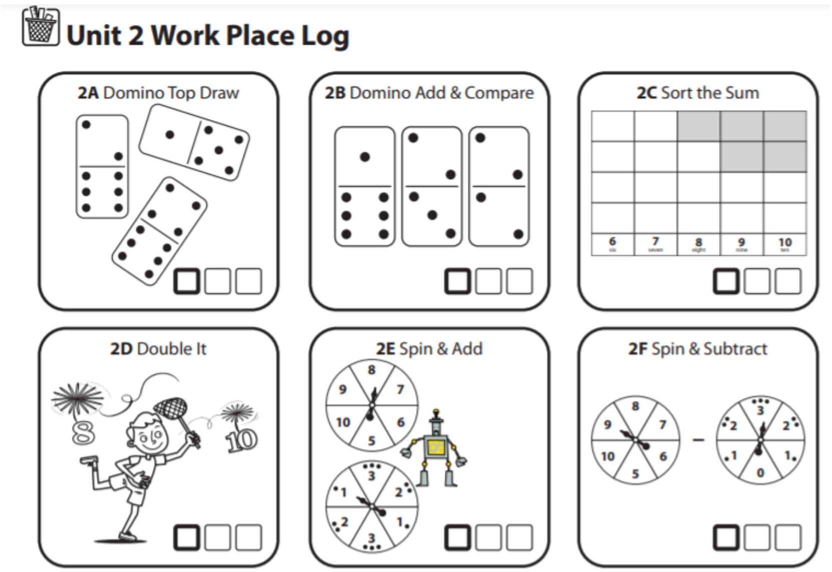
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 2 Domino Addition Checkpoint

Domino Addition Checkpoint, Part 1 Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Writes and solves a horizontal addition combination to match a domino with 5 dots on one-half and 3 dots on the other. *5 + 3 = 8*	1.OA.5 1.OA.6 1.MP.4	**2 pts.** 1 pt. for labeling each half of the domino correctly 1 pt. for solving the addition combination correctly	
1b Writes and solves a vertical addition combination to match a domino with 4 dots on one-half and 2 dots on the other. *4 + 2 = 6*	1.OA.5 1.OA.6 1.MP.4	**2 pts.** 1 pt. for labeling each half of the domino correctly 1 pt. for solving the addition combination correctly	
2a Draws dots on a domino to match a given addition combination, and solves the combination correctly. *3 dots, 4 dots, 7*	1.OA.5 1.OA.6 1.MP.4	**2 pts.** 1 pt. for drawing the correct number of dots on each half of the domino 1 pt. for solving the addition combination correctly	
2b Draws dots on a domino to match a given addition combination, and solves the combination correctly. *6 dots, 2 dots, 8*	1.OA.5 1.OA.6 1.MP.4	**2 pts.** 1 pt. for drawing the correct number of dots on each half of the domino 1 pt. for solving the addition combination correctly	
3a Labels two dominoes with the correct numbers, circles the domino with more dots, and uses the correct sign to show how the quantities of dots on the dominoes compare. *6, 8, circles the domino with 8 dots, records a less than sign (<) in the oval: "6 < 8"*	Supports K.CC 1.NBT.3 1.MP.4	**3 pts.** 1 pt. for labeling each domino with the correct total 1 pt. for circling the domino with more dots 1 pt. for recording the correct sign in the oval	
3b Labels two dominoes with the correct numbers, circles the domino with more dots, and uses the correct sign to show how the quantities of dots on the dominoes compare. *9, 5, circles the domino with 9 dots, records a greater than sign (>) in the oval: "9 > 5"*	Supports K.CC 1.NBT.3 1.MP.4	**3 pts.** 1 pt. for labeling each domino with the correct total 1 pt. for circling the domino with more dots 1 pt. for recording the correct sign in the oval	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**14 pts.**	

***4–14 points:** Working at Tier 1 or Tier 2 Level
3 points or fewer: May need Tier 3 Support

Domino Addition Checkpoint, Part 2 Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Determines the total number of dots on a domino and places it in the correct column.	1.OA.5 1.OA.6	**3 pts.** See Scoring Guidelines below	
1b Determines the total number of dots on a domino and places it in the correct column.	1.OA.5 1.OA.6	**3 pts.** See Scoring Guidelines below	
1c Determines the total number of dots on a domino and places it in the correct column.	1.OA.5 1.OA.6	**3 pts.** See Scoring Guidelines below	
1d Determines the total number of dots on a domino and places it in the correct column.	1.OA.5 1.OA.6	**3 pts.** See Scoring Guidelines below	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**12 pts.**	

***3–12 points:** Working at Tier 1 or Tier 2 Level
2 points or fewer: May need Tier 3 Support

Scoring Guidelines

- 0 points if the total reported by the student is incorrect
- 1 point if the student counts All the dots on the domino by 1s to find the correct total
- 2 points if the student counts on from one of the quantities on the domino to find the total (e.g., looks at a domino with 5 dots on one-half and 2 dots on the other and counts either 5 … 6, 7 or 2 … 3, 4, 5, 6, 7
- 3 points if the student simply knows the total, or uses a strategy more sophisticated than counting on to find the total, such as working from a known fact (e.g., looks at a domino with 5 dots on one-half and 4 on the other and reports that the total is 9 because 4 and 4 is 8, and 1 more is 9, or 5 and 5 is 10 and 1 less is 9)

- Unit 2 Post-Assessment

Unit 2 Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Given 4 dots on one-half of a domino, draw in enough on the other half to make a total of 5. Write an equation to match the completed domino. *1 more dot; 4 + 1 = 5*	1.OA.6 1.OA.8	**2 pts.** 1 pt. for drawing the correct number of dots 1 pt. for writing an equation that matches the completed domino	
1b Given 3 dots on one-half of a domino, draw in enough on the other half to make a total of 6. Write an equation to match the completed domino. *3 more dots; 3 + 3 = 6*	1.OA.6 1.OA.8	**2 pts.** 1 pt. for drawing the correct number of dots 1 pt. for writing an equation that matches the completed domino	
1c Given 5 dots on one-half of a domino, draw in enough on the other half to make a total of 7. Write an equation to match the completed domino. *2 more dots; 5 + 2 = 7*	1.OA.6 1.OA.8	**2 pts.** 1 pt. for drawing the correct number of dots 1 pt. for writing an equation that matches the completed domino	
2 Fill in the missing number in each of 4 equations that represent a double-flap card with 4 dogs on one side and 2 on the other. Write a story problem to match one of the equations. *6, 4, 2, 2; story problems will vary.*	1.OA.3 1.OA.4 1.OA.6 1.OA.8	**6 pts.** 1 pt. for each equation completed correctly and 1 or 2 pts. for the story problem: • 1 pt. for a story problem that does match one of the equations but does not include a question OR • 2 pts. for a story problem that does match one of the equations AND includes a question	
3 Solve 15 combinations that involve adding 0, 1, 2, and 3, as well as doubles to 10, within 3 minutes. *6, 6, 6, 8, 10; 6, 8, 8, 7, 9; 9, 7, 10, 10, 4*	1.OA.6	**15 pts.** 1 pt. for each correct answer recorded during the 3-minute timing	
4 Solve a story problem that involves finding the missing subtrahend. Show work, and record the answer on the line. *4 bugs got away; students' work will vary.*	1.OA.1 1.OA.4	**3 pts** 1 pt. for using the information in the problem 1 pt. for showing work that could lead to the correct answer 1 pt. for the correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**30 pts.**	

* **Meeting Standard** 22–30 points (75–100% correct) **Approaching Standard** 15–21 points (50–74% correct) **Strategic** 7–14 points (25–49% correct) **Intensive** 6 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 3: Adding, Subtracting, Counting & Comparing
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
1.OA.1 Solve addition and subtraction story problems with sums and minuends to 20 involving situations of adding to, putting together, taking from, taking apart, and comparing with unknowns in all positions
1.OA.3 Apply the commutative and associative properties of addition to add

1.OA.4 Solve subtraction problems by finding an unknown addend
1.OA.5 Solve addition and subtraction problems by counting on and counting back
1.OA.6 Add and subtract fluently with sums and minuends to 10, and use strategies to add with sums to 20
1.OA.7 Demonstrate an understanding that the equal sign indicates equivalence and determine whether addition equations are true
1.OA.8 Solve for the unknown in an addition or subtraction equation involving 3 whole numbers

Supporting Standards:

1.NBT Group and count objects by 2s, 5s and 10s
1.NBT.1 Read numerals to 120
1.NBT.2 Demonstrate an understanding that the digits in a 2-digit number represent amounts of tens and ones
1.NBT.3 Compare pairs of 2-digit numbers
1.NBT.4 Add a 1-digit number and a 2-digit number
1.MD.4 Organize, represent, and interpret data with up to 3 categories

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Apply the associative property to add.	1. Changing the grouping of addends does not change the sum.
2. Add fluently with sums to 10.	2. Addition facts to 10.
3. Solve for an unknown in an addition equation involving 3 whole numbers.	3. Part-part-whole reasoning, difference between addition and subtraction, and equivalence.
	4. Data can be organized in graphs, charts, and tables to represent quantities in data for efficient counting.

4. Organize, represent, and interpret data with up to three categories.	5. Whole numbers can be added in any order and the sum will remain the same.
5. Apply the commutative property to add.	6. There is a connection between addition and counting; adding 2 is the same as counting on two.
6. Solve addition problems by counting on.	7. Addition facts can be solved in different ways including making 10, counting on, and doubles.
7. Use strategies to add sums to 20.	8. Divide objects in two equal groups, with or without a remainder.
8. Determine whether a group of objects (up to 20) has an odd or even number of members.	9. Whole numbers can be classified as being odd (indivisible evenly by 2) or even (divisible evenly by 2).
9. Identify whether a number is odd or even.	10. Backward counting sequence within 20.
10. Solve subtraction problems by counting back.	11. Subtraction is the inverse operation of addition.
11. Solve subtraction problems by finding an unknown addend.	12. Expressions and/or whole numbers on either side of the equal side represent the same quantity.
12. Demonstrate an understanding that the equal sign indicates equivalence.	

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can you break numbers into parts of a whole? 2. How are addition and subtraction related? 3. How can you identify a doubles fact? 4. Why is it helpful to make a 10 when adding?	1. Numbers are composed of smaller numbers and can be decomposed. 2. Addition and subtraction are the inverse operations of each other which can be demonstrated with fact families. 3. Doubling a number is adding a number to itself. 4. Composing numbers into 10s makes operations easier.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.c:** break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Informational Texts:
• **Informational Books:**
  ○ Double Those Wheels
  ○ Equal Shmequal
• **Media:**
  ○ Even Number Song
  ○ Odd Number Song
 	
Online Resources / Websites:
MLC Apps:
• Number Frames App
• Number Rack App

Games:

- Bonds of Ten
- Fuzz Bugs Number Bond
- Jet Ski Addition
- Ten Frame
- Alien Addition
- Grouping and Grazing
- Number Balance
- Comparing Number Values

Apps:

- Math Tappers: Find Sums
- Number Flash

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:
Add: to combine; to put together two or more quantities.
Compare: to examine in order to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Equal: of the same amount or value.
Equation: a math statement asserting that two quantities have the same value.
Greater than: a symbol used to indicate that the number on the left is greater than the number on the right.
Half: one part when a number, shape or set is divided into exactly two equal parts.
Less than: a symbol used to indicate that the number on the left is less than the number on the right.
Ones: the numbers 0-9; also refers to the ones place.
Subtract: to take one quantity away from another or find the difference between two quantities.
Sum or Total: the result of adding two or more numbers.
Tens: the numbers 10-99; also refers to the tens place.

Learning Plan

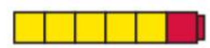
Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Unit 3 encourages student mastery of key number facts and fact strategies for single-digit addition and subtraction. The first two weeks use the number rack to help students see number combinations, find the sum of two numbers, and compare two numbers to find the difference between them. The third week focuses on developing place-value understanding and solving addition combinations to 20, and the final week makes use of Unifix cubes to help students develop understanding of the difference model of subtraction.

Week One: Week 1 focuses on single-digit number facts. Each of the three Work Place activities introduced is designed to encourage facility with number fact families, including doubles relationships. The number rack is used strategically throughout as a tool to model addition story problems. It also plays an important role in helping students conceptualize the difference between even and odd numbers and understand how knowing the nature of even and odd numbers can help solve addition problems.

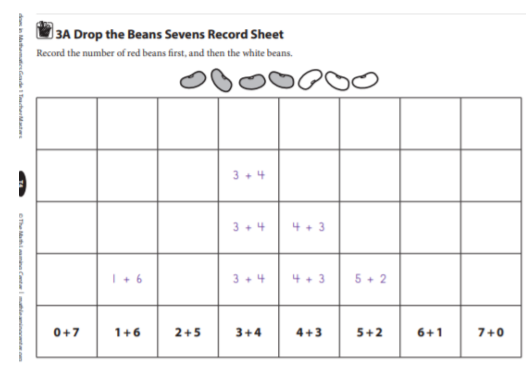
Practice make ten combinations with *I Have, You Need*:
As a warmup activity use ten as the target number. Use trains of 10 unifix cubes in 2 colors of 5 for visual support. Give students their own trains as needed.



Teacher *(Holds up 6 cubes) I have 6.*

Teacher *Use your cubes to figure out how many I need to make 10—wait for my signal to say it.* (Gives students a few moments to figure it out and then gives the signal.) *OK!*

Practice addition facts to ten with *Drop the Beans*:
Using two-colored beans (or counters)



3A Drop the Beans Sevens Record Sheet

Record the number of red beans first, and then the white beans.

			3 + 4				
			3 + 4	4 + 3			
	1 + 6		3 + 4	4 + 3	5 + 2		
0+7	**1+6**	**2+5**	**3+4**	**4+3**	**5+2**	**6+1**	**7+0**

- Each player chooses a target sum and gets that number of plastic counting beans and the corresponding record sheet.
- The player cups the beans in their hand, drops them gently, and counts how many reds came up and how many whites.
- The player records an expression in the correct column on the record sheet, starting at the bottom.
- Play continues until two columns are filled.

Here are some questions and prompts you might use during the discussion:

- Share any observations you have about our graph with the person next to you.
- Which combination came up first for most often? Least often?
- Why did so many students have 3 + 4 or 4 + 3 come in first, do you think?
- Why did so few of us have combinations of 0 + 7 and 7 + 0 come in first?
- Were there other combinations that didn't come in first very often? What were they?
- If you had 8 red and white beans instead of 7, which combinations do you think would come up most often?

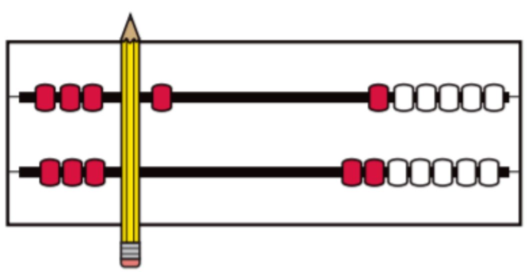
Practice addition facts to ten with *Make the Sum*:
After removing all ten-frame cards greater than target number, summarize the game. Students who are ready for a challenge can play with number cards.

- Partners decide on a target sum between 5 and 10. They take turns drawing from a deck of Ten-Frame Dot Cards and laying the cards they draw next to the stack.
- The object is to make the target sum with any available cards. If a player makes the sum, she gets to take those cards.
- Play continues until all of the cards that can be used to make sums have been played. Players count their cards, and the one with the most is the winner.

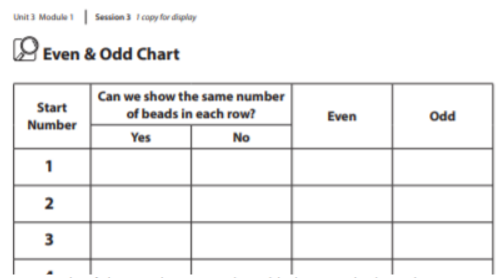
Introduce concepts of doubling and halving:
Ask students to hold up 2 fingers on one hand and then on the other.
Repeat with all numbers 1-5.

- Now how many fingers are there in all?
- What is half of 4?
- What is 2 doubled?
- What equation would we write to represent what we're showing on our fingers? (2 + 2 = 4)

Use math rack to explore odd and even numbers:
Ask students if 6 be shown on the math rack with the same number of beads on the top and bottom row. Repeat with 7. Explain that even numbers can be split into two equal groups. Odd numbers cannot be split into two equal groups. Use the math rack for visual support of odd and even. Repeat with numbers to 20 and record results.



Seven is an odd number. Two groups of 3, and … 1 more.



Unit 3 Module 1 | Session 3 1 copy for display

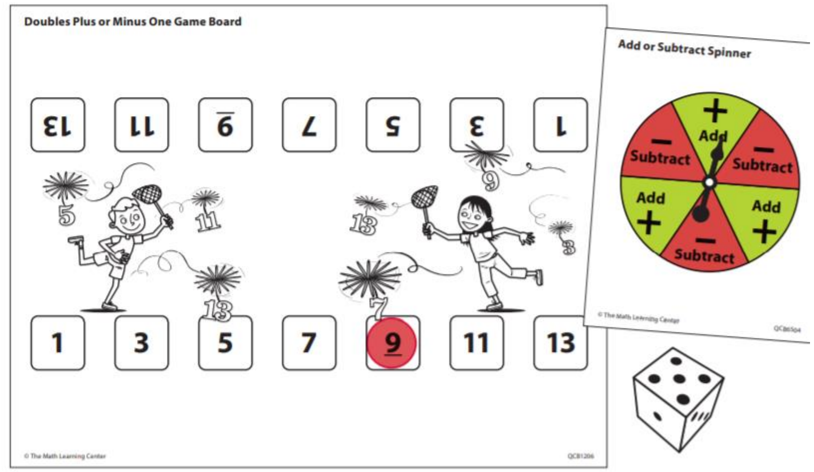
Even & Odd Chart

Start Number	Can we show the same number of beads in each row?		Even	Odd
	Yes	No		
1				
2				
3				

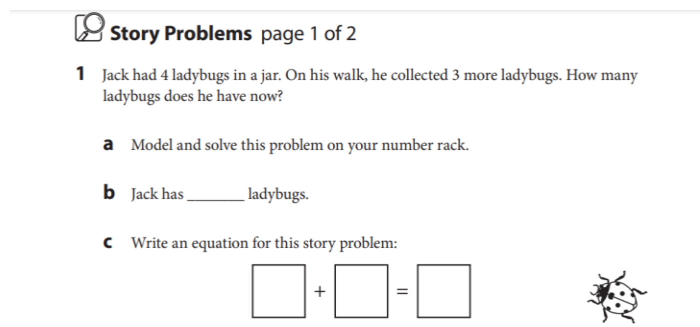
- Write each of the combinations listed below on the board, one at a time.
  » 3 + 4
  » 2 + 3
  » 4 + 5
  » 1 + 2
  » 5 + 6
- Ask students to model each combination on their number rack and explain how doubles help to get the answer.
- Acknowledge the fact that in each case, you can count on to get the answer, but press students to verbalize strategies that use the doubles facts.

Introduce idea of doubles plus or minus one (near doubles):
Model 3 + 4 using the top and bottom rows of a math rack. Discuss how the double 3 + 3 can help think about 3 + 4 (3 + 3 + 1).

Practice using double facts to solve near doubles with *Doubles Plus or Minus One*:
Explain this game is like *Double It* from Unit 2 but adds a plus or minus one spinner.



Use a number rack to model a variety of addition and subtraction problems:
The teacher and the class will work together to model addition problems on their number racks. Then the students will be given addition and subtraction story problems to solve with the aid of their number racks.


Story Problems page 1 of 2

1 Jack had 4 ladybugs in a jar. On his walk, he collected 3 more ladybugs. How many ladybugs does he have now?

a Model and solve this problem on your number rack.

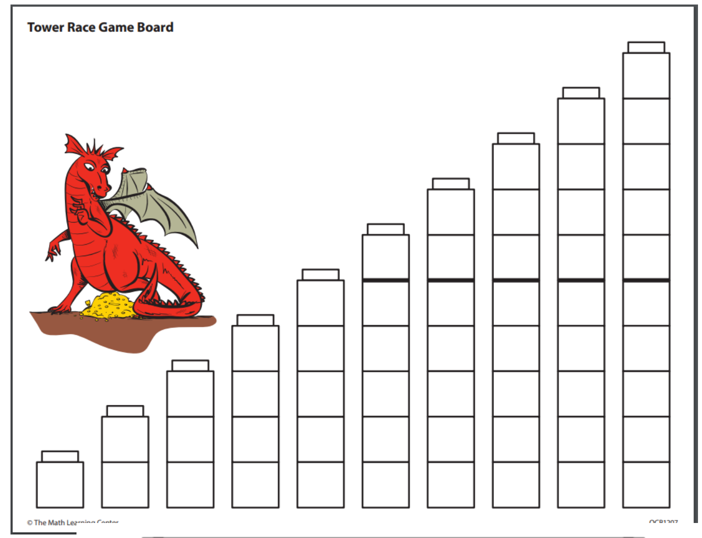
b Jack has _______ ladybugs.

c Write an equation for this story problem:

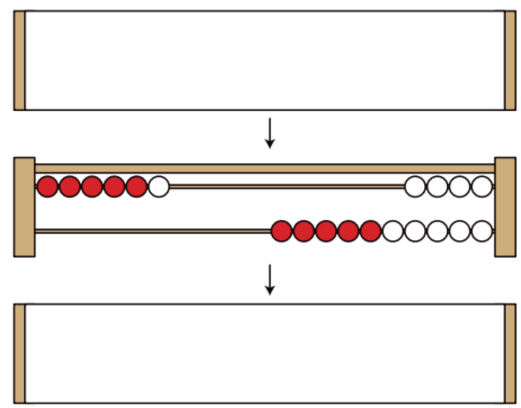
☐ + ☐ = ☐

Week Two: In Week 2, the focus is again on addition and subtraction facts. The number rack is used to help students recognize number combinations (primarily to 10), subitize (recognize subsets within a given quantity), find the sum of two numbers, and compare two numbers to find the difference between them. This module introduces two Work Place activities, each designed to develop student confidence with number combinations in the range of 0 to 10. Session 4 provides a short-written checkpoint assessment.

Practice decomposing numbers less than or equal to 10 playing a game called *Tower Race:*
Students will roll two dice and collect those numbers of cubes in two different colors. The students will use those cubes to fill a set of towers, 1-10, on a gameboard.

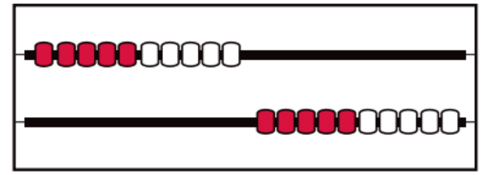


Students will practice subitizing by playing *Flash Attack:*
The teacher will show some beads on a demonstration number rack for 2 to 3 seconds before hiding them. Students will then show with their fingers how many beads they saw.

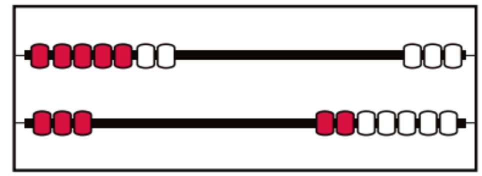


How many beads can you see on the left?
See if you can figure it out in just a couple seconds! Ready … go!

Students will find various combinations of 10:
Students and the teacher will each have a number rack. Start with moving 5 red beads on the top row to the left. Ask students how many more beads are needed to make 10. Repeat with other combinations of 10, asking the students to explain their thinking.

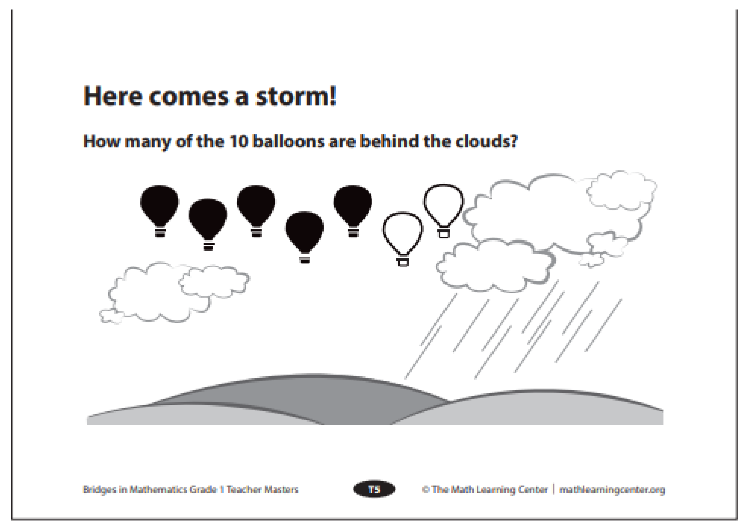


I just moved over 3 more on the top row.



I moved 3 on the bottom row. I can tell it's 10 because 3 and 3 is 6, and then 4 more makes 10.

Students will solve Hot Air Balloon stories to explore part-part-whole relationships:
Students are told there are 5 black and 5 white hot air balloons racing in the sky. Some of the balloons are hidden by clouds. Students use number racks to solve the missing part problems. Next, increase the number of balloons to 20 (10 black and 10 white).


Here comes a storm!

How many of the 10 balloons are behind the clouds?

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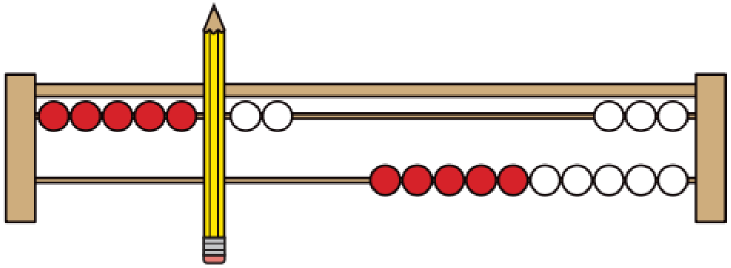
Introduce the idea of subtraction as a process of comparing two quantities:
Students use their number racks to visualize that subtraction is the comparison of two quantities. The minuend is represented by the top row and the subtrahend is represented by the bottom row. The extra beads in the top row represents the difference.

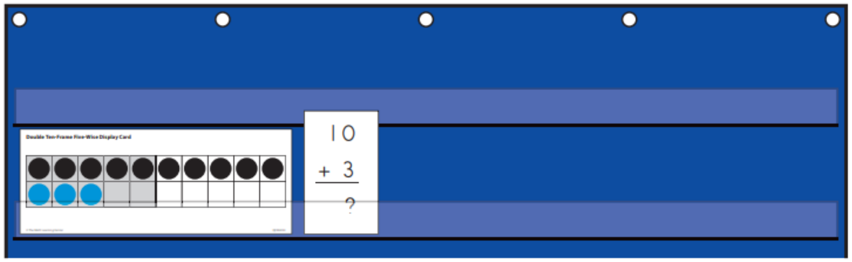


Teacher *The gym teacher has 7 soccer balls and 5 basketballs for the kids to use at recess. How many more soccer balls than basketballs does she have? Take a close look at the model we've set up on the number rack and tell the person next to you how many more soccer balls there are.*

Students *Two!*
You can see it's two extra.
She has more soccer balls because more kids like to play soccer!

Week Three: Putting together "10 and some more" to make the numbers from 11 to 20 is the core work of this module. Students build place-value understandings and use the Make Ten strategy to become more efficient at solving addition combinations to 20. The first session introduces the concepts of 10s and 1s and the idea that they can be put together to make a teen number. In the three sessions that follow, students learn the Fifty or Bust! game, in which they build and add collections of numbers between 10 and 20, trying to get to 50 without going over. They write equations for their collections as well. Week 3 includes one new Work Place. It ends with a unit assessment.

Introduce the concept of teen numbers being "10 and Some More":
Students will match Double Ten-Frame cards showing teen numbers with the associated math fact card. Students will then model the "10 and Some More" fact with Unifix cubes and record the math fact.



Students *I see a plus.*
It's adding. It makes 13, but it has a question mark.
It's the same as the card.

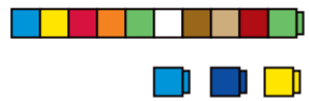
Teacher *What do you mean, it's the same as the card?*

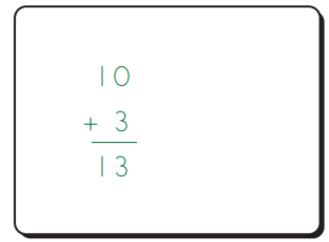
Student *The card shows 13, too.*

Teacher *Can you come up and show us how you see the 13?*

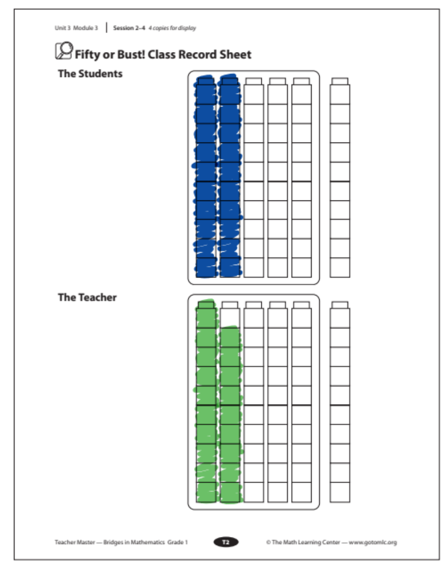
Student *See, here's 10 in this box and then 3 more, and that's 13.*

Teacher *So the card shows 10 and 3 more, and the addition fact says 10 + 3, and they both equal 13.*



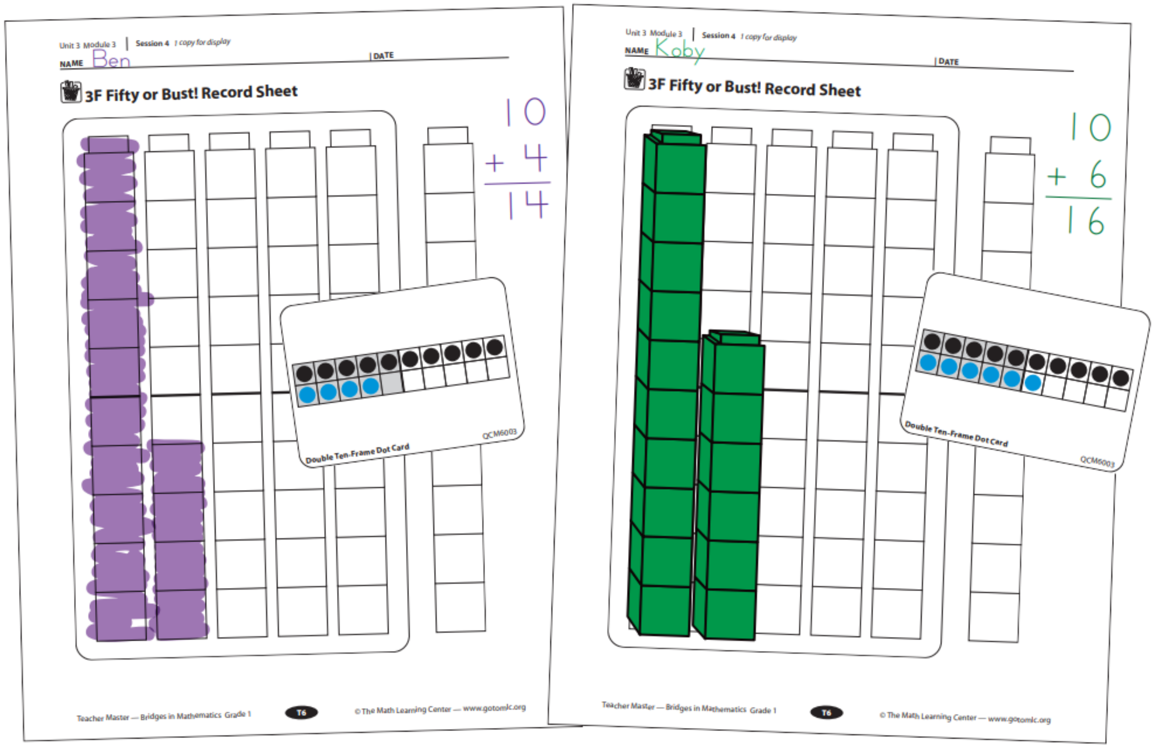


Students practice building teen numbers by playing *Fifty or Bust!*
The teacher and class take turns drawing Double Ten-Frame cards and building the number on that card with a tower of Unifix cubes. Everyone also records those towers on the Fifty or Bust! Record Sheet. Whoever can get the closest to 50 without going over is the winner!

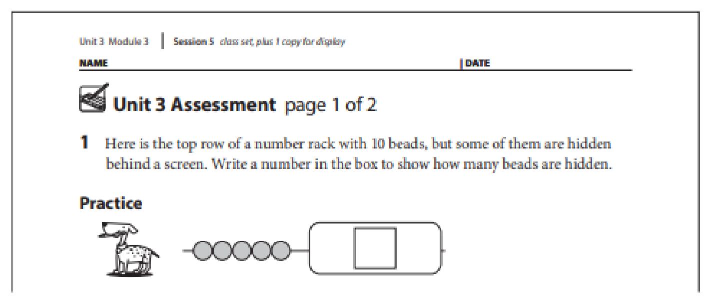


Students continue their practice with teen numbers by playing *Fifty or Bust!* against each other:

Students will pair up and use the student-sized Double Ten-Frame cards to play *Fifty or Bust!* Each student gets their own recording sheet. The student who gets closest to 50 without going over is the winner.



Ben I got 14 and you got 16. You have 2 more than me right now.
Koby I need 10, 20, 30, 31, 32, 33, 34 more to get to 50. I think you need 36 mor

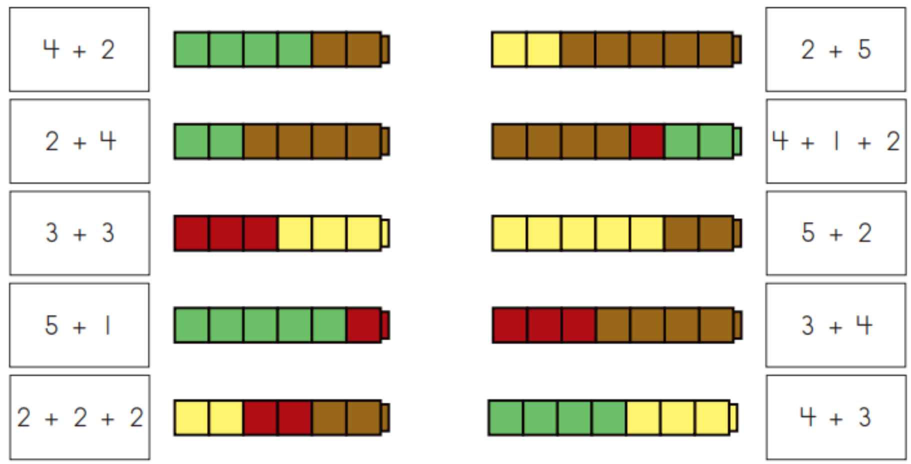

Unit 3 Module 3 | Session 5 class set, plus 1 copy for display
NAME | DATE
Unit 3 Assessment page 1 of 2
1 Here is the top row of a number rack with 10 beads, but some of them are hidden behind a screen. Write a number in the box to show how many beads are hidden.
Practice

Administer Unit 3 Assessment:
Complete practice problems and review together. Read directions aloud

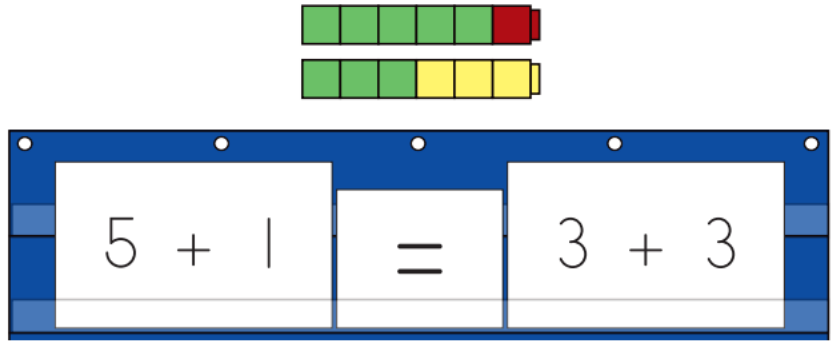
and allow students to work independently.

Week Four: Week 4 uses Unifix cubes throughout. Students have opportunities in the first two sessions to write addition expressions and compare equations within the range of 0 to 120. Later in the module, students engage in activities that highlight the "difference model" of subtraction. The final session encourages students to explore part-part-whole relationships to develop and solve subtraction equations in which the subtrahend is missing.

Use Unifix Cubes to find various ways to make 6 and 7
Ask students to make three towers of Unifix cubes: each tower should have 6 or 7 cubes and be made of two different colors. Students will share with the class and record expressions for each tower.

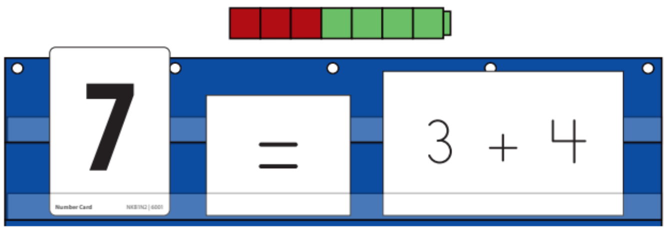


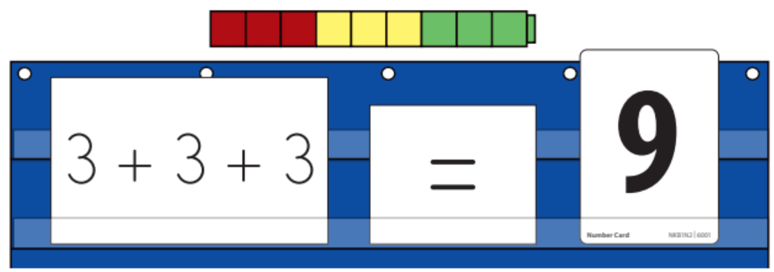
Turn mathematical expressions into equations and introduce the concept of equivalent expressions.



Teacher *Is this true? Is 5 + 1 really the same as 3 + 3? Talk with the person next to you for a moment, and then let's have some of you share your thinking with the class.*

Students *They're both 6, so they're kind of the same.*
The numbers look different, but both trains have 6 in them.
Five and 1 is 6, right? Then 3 and 3 is 6. So they're the same.

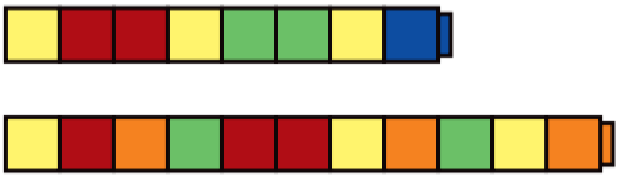




Students *Yep, that one's true.*
I put a T for true.
Three plus 3 is 6, and then 3 more is 9.
You can see it's right because there are 9 cubes on that train.

Use Unifix cubes to make the number 9 or 10 using three different colors:
Repeat the two previous learning tasks but now have the students make towers with 9 or 10 cubes. The students may now use three different colors.
Compare cube trains and use inequality symbols:
Students will grab two handfuls of Unifix cubes and compare

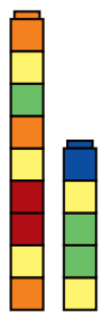
the quantities. The class will record the findings on a chart, utilizing the correct inequality sign and an addition equation to show how many more cubes are needed for the lesser number to "catch up".



Comparing Cube Trains

Student 1		Student 2	How many to catch up?
8	$<$	11	$8 + 3 = 11$

Compare quantities using subtraction:
Students will once again grab two handfuls of Unifix cubes and compare the quantities. This time, students will record how many cubes the two quantities have in common, what the difference is, and the associated subtraction equation.



Comparing Cube Towers

Tower 1	Tower 2	How many cubes in common	What's the difference?	Subtraction Equation
9 cubes	5 cubes	5	4	$9 - 5 = 4$

Interdisciplinary / Real World / Global Connections

- Students notice things that come in pairs: car wheels, insect legs, their own eyes, hands, and feet. This makes doubles facts one of the first strategies they learn.
- Addition helps kids master the relationships between numbers and understand how quantities relate to one another.
- Subtraction will be used when spending money or making change.
- Students will use adding when they are counting their money or counting other things like pencils, books, flowers, make up, dresses, shoes, and more.
- We see whole numbers on nutrition labels, or signs on the highway telling us how many miles are to the next exit/city.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively
☐ Writing effectively for a variety of purposes
☐ Presenting ideas accurately with the support of engaging media
☒ Thinking critically to solve problems and reach well-reasoned judgments
☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall

- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

English Language Learners (ELL):

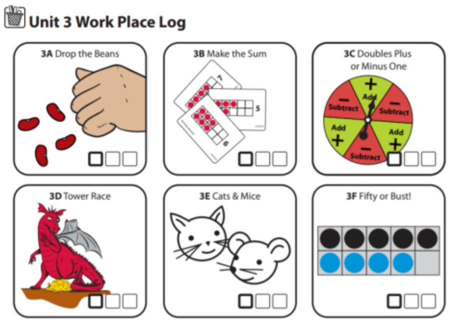
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Combinations of Ten Checkpoint

Combinations of Ten Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–e Writes a number to show how many beads are hidden on the top row of the number rack. *5, 2, 4, 3, 7*	1.OA.6 1.OA.8	**5 pts.** • 1 pt. for each correct answer	
2 Subtracts various numbers from 10 correctly. *4, 5, 7, 6, 1, 3, 2*	1.OA.4 1.OA.6	**7 pts.** • 1 pt. for each correct answer	
3 Writes three different equations for 10. *Students' responses will vary. Examples: 6 + 4 = 10, 1 + 2 + 3 + 4 = 10, 12 – 2 = 10, 100 – 90 = 10, and so on*	1.MP.4	**3 pts.** • 1 pt. for each equation that equals 10 (Do not dock points if students write expressions rather than equations (e.g., 6 + 4) or forget to include the equal sign (e.g., 6 + 4 10)	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**15 pts.**	

* **4–15 points:** Working at Tier 1 or Tier 2 Level
3 points or fewer: May need Tier 3 Support

- Unit 3 Post-Assessment

Unit 3 Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Writes a number to show how many beads are hidden on the top row of the number rack. *9, 6, 3, 8, 4, 1*	1.OA.6 1.OA.8	**6 pts.** • 1 pt. for each correct answer	
2 Within three minutes, solves 14 combinations that involve adding 0, 1, 2, and 10; doubles and doubles plus or minus 1; and combinations of 10. *6, 7, 8, 9, 10, 10, 9, 9, 13, 17, 19, 10, 10, 10*	1.OA.6 1.NBT.4	**14 pts.** • 1 pt. for each correct answer recorded during the 3-minute timing	
3a–d Counts to determine how many Unifix cubes grouped into 10s and 1s there are in each collection. *16, 12, 18, 26*	1.NBT.1 1.NBT.2 1.NBT.2a 1.NBT.2b	**4 pts.** • 1 pt. for each correct answer	
4 Solves a subtraction story problem that involves a situation of comparing. Shows work. *There are 7 more hot air balloons in the air than on the ground.*	1.OA.1	**3 pts.** • 1 pt. for using the information in the problem • 1 pt. for showing work that could lead to the correct answer • 1 pt. for the correct answer	
5 Subtracts various numbers from 10 correctly. *8, 5, 4, 1*	**1.OA.4** 1.OA.6	**4 pts.** • 1 pt. for each correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**31 pts.**	

* **Meeting Standard** 24–31 points (75%–100% correct) **Approaching Standard** 16–23 points (50–74% correct) **Strategic** 8–15 points (25–49% correct) **Intensive** 7 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 4: Leapfrogs on the Number Line
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** 1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. Construct viable arguments and critique reasoning of others. 4. **Model with mathematics.** 5. Use appropriate tools strategically. 6. Attend to precision. 7. **Look for and make use of structure.** 8. Look for and express regularity in repeated reasoning. **Priority/Focus Standards:** 1.OA.1 Solve addition and subtraction story problems with sums and minuends to 20 involving situations of adding to, putting together, taking from, taking apart, and comparing with unknowns in all positions 1.OA.5 Solve addition and subtraction problems by counting on and counting back

1.OA.6 Add and subtract fluently with sums and minuends to 10, and use strategies to add with sums to 20
1.OA.8 Solve for the unknown in an addition or subtraction equation involving 3 whole numbers
1.NBT.1 Count to 120, starting with any number less than 120, including 0 or 1. Read numerals to 120
1.NBT.2c Demonstrate an understanding that multiples of 10 from 10 to 90 refer to some number of tens and 0 ones
1.NBT.3 Use >, =, and < symbols to record comparisons of two 2-digit numbers
1.NBT.4 Add a 1-digit number and a 2-digit number
1.NBT.4 Add a multiple of 10 (up to 80) and another 2-digit number
1.NBT.4 Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to add with sums to 100
1.NBT.5 Mentally find the number that is 10 more or 10 less than a given 2-digit number, without counting, and explain the reasoning used
1.NBT.6 Use concrete models or drawings to subtract a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10
1.NBT.6 Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to subtract a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10

Supporting Standards:
1.OA Represent addition and subtraction on a number line
1.OA Recognize, describe, and extend number patterns
1.NBT Count by 5s and 10s to 100

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Count to 120, starting with any number less than 120, including 0 or 1. 2. Read numerals to 120.	1. Forward/Backward counting sequence to 100 and counting sequence by 2’s, 5’s and 10’s 2. Quantities can be represented by numerals and number

3. Add within 20. 4. Count by 5's to 100. 5. Group and count objects by 5s. 6. Count by 10s to 100. 7. Determine if one quantity is greater than, less than or equal to another quantity. 8. Use >, <, = symbols to compare numbers. 9. Measure length with nun-standard units.	names. 3. Part-part-whole reasoning, the commutative property of addition to add, and equivalence. 4. Forward/Backward counting sequence to 100 and counting sequence by 2's, 5's and 10's 5. Forward/Backward counting sequence to 100 and counting sequence by 2's, 5's and 10's 6. Forward/Backward counting sequence to 100 and counting sequences by 2's, 5's and 10's. 7. Numbers in our counting sequence increase in value as we count forward and decrease in value as we count backwards. 8. The meaning of mathematical symbols for comparison and equality. 9. Measurement allows for the comparison of quantities.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can you use groups of 5 or 10 to count? 2. How can you identify patterns when you count from 1 to 120? 3. How can you use tens to make up each of the numbers from 10 to 90?	1. Grouping objects makes counting and operations easier. 2. Utilizing the patterns in the number system can make counting easier. 3. The counting-by-tens numbers can be decomposed into groups of 10

4. How can you explain how adding groups of 10 is like adding numbers less than 10? 5. How can you use nonstandard units to measure and compare the lengths and heights of objects? 6. How can you compare the lengths of two objects when they are in different places?	4. Multiples of 10s follow the same patterns as one-digit numbers. 5. Using the same unit (even a nonstandard one) repeatedly can determine the length of an object. 6. Measurement with an agreed upon unit allows for comparison of different objects.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

When using Tech-Enhanced Activities (TEAs), the following standard will be used.

Standard 1.5.b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Informational Texts:

- **Informational Books:**
  - Lots of Frogs
  - The Penguin Lady
  - Arctic Fives Arrive
  - Measurement Books
  - Twelve Snails to One Lizard
- **Media:**
  - Counting by Tens
  - Count by Fives

MLC Apps:

- Number Rack App

- Penguin Addition and Subtraction Facts

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:
Add: to combine; to put together two or more quantities.
Compare: to examine in order to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Data: items of information; may include facts, numbers, or measurements.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Equal: of exactly the same amount or value.
Equation: a math statement asserting that two quantities have the same value.
Half: one part when a number, shape or set is divided into exactly two equal parts.
Height: how tall something is; the measurement from top to bottom of an object or a shape.
Inch (in.): a U.S. customary unit of length equal to 1/12 of a foot.
Less than: a symbol used to indicate that the number on the left is less than the number on the right.
Long / Longer / Longest: having considerable length / having a length that is more than that of another object / having a length that is the greatest of three or more objects.
Number Line: a diagram in which numbers are represented as points on a line.
Short / Shorter / Shortest: having small length / having a length that is less than that of another object / having a length that is the least of three or more objects.
Subtract: to take one quantity away from another or find the difference between two quantities.
Sum or Total: the result of adding two or more numbers.
Tens: the numbers 10-99; also refers to the tens place.

Learning Plan

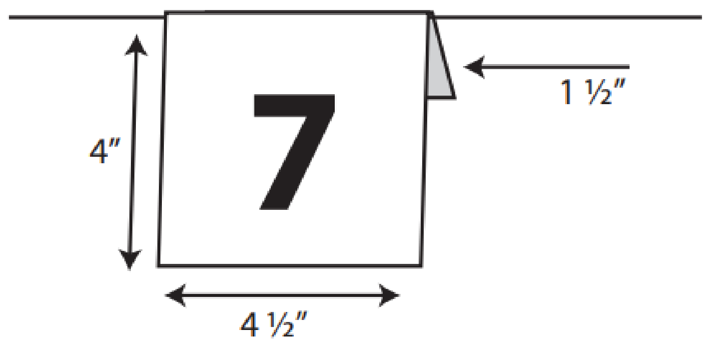
Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Unit 4 revolves around the number line, an essential mathematical model. Throughout, closed and open number lines are used both as models of our number system, as well as models for beginning operations with addition and subtraction. Students locate numbers on a number line, use their reasoning skills and number sense to determine unknown values that correspond to empty boxes, and explore addition and subtraction. As the unit unfolds, the range of numbers represented grows from 0–20 to 0–120. Students become comfortable skip-jumping along open number lines in multiples of 5 and 10, forward and backward, from numbers that are both on and off the decade. In the concluding module, students measure penguins and then compare and order those measurements, write inequality statements, and find differences between the two numbers.

Week One: Week 1 works to familiarize students with the number line as a mathematical model and an operational tool. Students use a life-sized number line to locate and identify numbers, and to begin to model addition and subtraction problems. Later they play a game in which they help a frog jump along a number line. In addition to helping students develop confidence with the number line as a computational tool, the activity helps deepen their understanding about the relationship between addition and subtraction.

Students build a life-sized number line from 0 to 20:
The teacher hangs a string at least 12 feet long along the wall. Students will work together to hang the numbers 0 through 20 on the string. Once the numbers are arranged correctly, have the class count together forwards and backwards from 0 to 20. See the diagram to prepare the number cards for hanging.

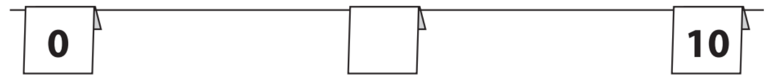


Students will determine missing numbers on a life-sized number line:
Use the life-sized number line from the previous learning task. Place various numbers at the beginning and end. Then place a blank card on the number line. Have students work together to determine what number goes on the blank card.

What number belongs in the empty box? How do you know?

What number belongs in the empty box? How do you know?

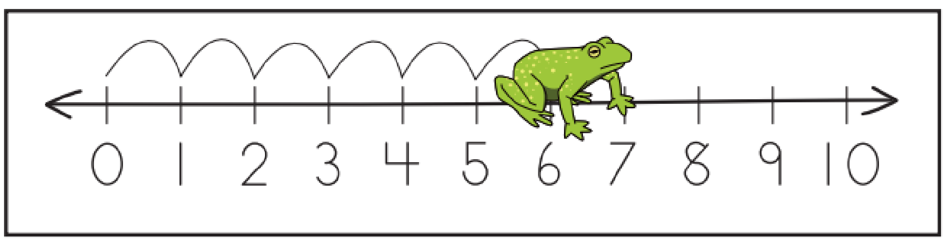
Now what number belongs in the empty box? How do you know?



Now what number belongs in the empty box? How do you know?

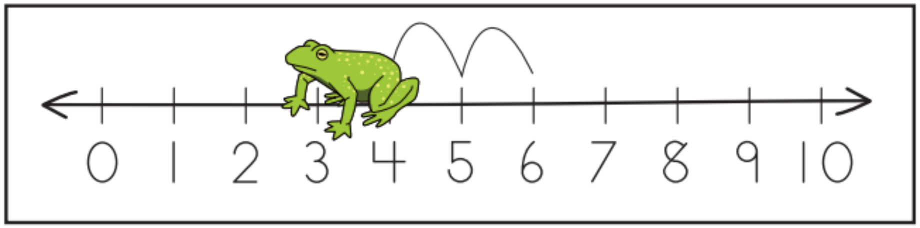
Students will use a number line to model addition and subtraction:
Using a number line numbered 0 to 10, students will model story problems about Little Frog on the number line and record the accompanying addition and subtraction equations.

One day, Little Frog was sitting on the number 0 enjoying the morning sun. Suddenly, she saw a tasty bug fly past. She decided to try to catch it. She made 4 hops. (Where is she now? That's right, she's on the 4.) Then she made 2 more hops. (Where did she land? Right, she's on the 6 now.)



$4 + 2 = 6$

Little Frog helps us see that 4 + 2 is 6, but she didn't get the bug. The bug flew right back over her head! Little Frog turned around and took 2 hops back the other way. Where do you think she's going to land?



$4 + 2 = 6$

$6 - 2 = 4$

Students practice modeling addition or subtraction while playing *The Frog Jump Game*:
Each player draws two number cards and spins the Add or Subtract spinner. The student models that operation on the number line with a paper frog. The student with the greater answer wins the round.

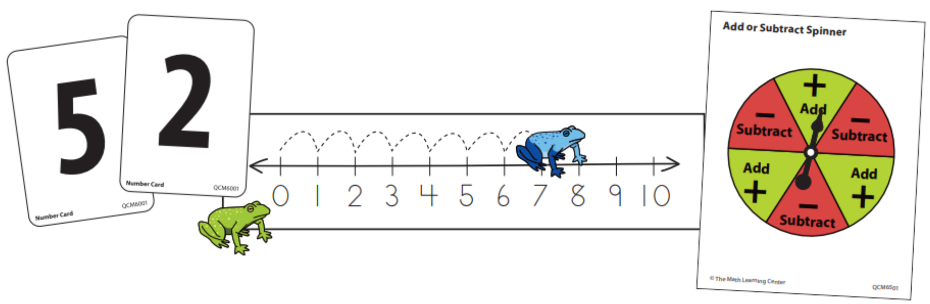
Teacher *Here are the cards I got. What do they say?*

Students *Five and 2.*
If you add 5 plus 2, you get 7!
But we have to spin that spinner first.

Teacher *So my spin landed on Add. I'll arrange the cards and spinner like this: 5 + 2.*

5 Tell a story to match the equation as you move your frog along the number line.

Teacher *Let me think of a good story to go with this addition expression. OK, my little frog went out to find some bugs to eat. First she took 5 hops to the 5th rock. She didn't find any bugs there, so she took 2 more hops. Where did she land?*



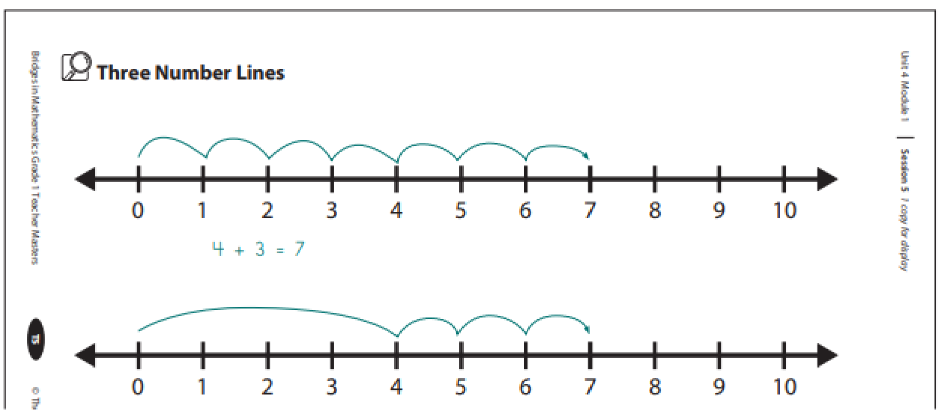
Students compare addition strategies on a number line:

Write the expression 4 + 3 below the first number line on the Three Number Lines Teacher Master, and read it with students. Ask them to think about the answer and discuss it with the person sitting next to them. Then have several students share their solutions and explain their thinking.

> ***Students*** *It's 7.*
> *I put up 4 on this hand and 3 on the other, and counted them up. I got 7.*
> *It's 7 because I went 4, then 5, 6, 7.*
> *I know it's 7 because 3 and 3 is 6, and then 1 more is 7.*

Use and compare a counting-by-1s strategy with a counting-on strategy.

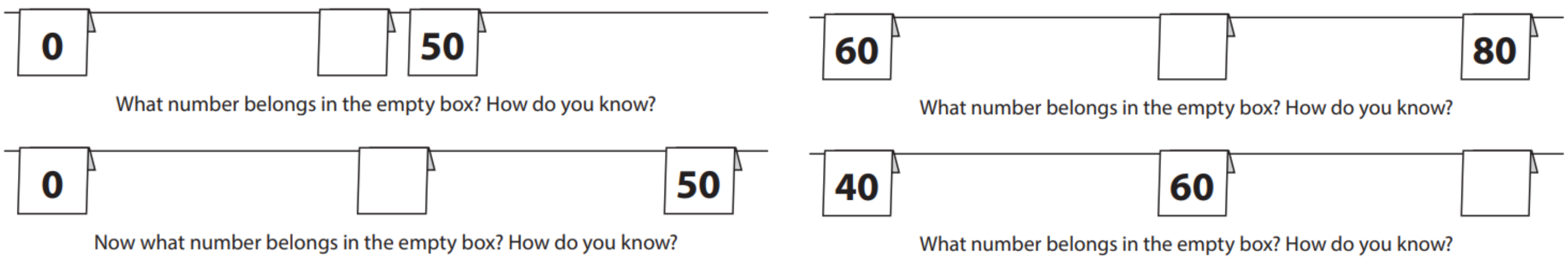
- Use the first number line to model a by 1s counting strategy for finding the sum.
- Then model a counting-on strategy on the second line by jumping to the 4 and then making 3 more hops.
- Discuss both strategies with the students. Do both methods work? Which one is faster? Why?



Week Two: In Week 2, students work on the number line as they continue to develop a rich sense of numbers and number relationships. This engaging module challenges students' reasoning abilities as they work to determine the value of empty number boxes placed strategically on the open number line. Students help frogs move across stones on a number line in jumps that include multiples of 5 and 10, tell stories about the frogs' actions, and record equations to match. A checkpoint assesses students' ability to navigate on a number line in the range of 0–120.

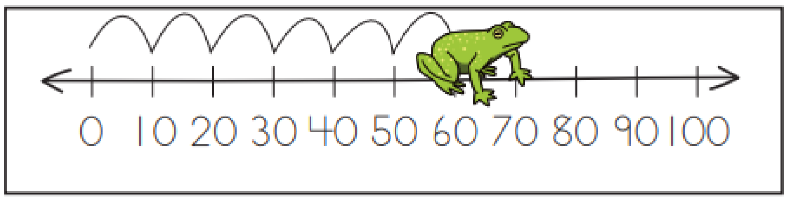
Students build a life-sized number line with multiples of 10 from 0 to 100:
Use the hanging string from last week. Students will work together to hang multiples of 10 from 0 through 100 on the string. Once the numbers are arranged correctly, have the class count together forwards and backwards by 10s from 0 to 100.

Students will determine missing numbers on a life-sized number line from 0 to 100:
Use the life-sized number line from the previous learning task. Place various numbers at the beginning and end. Then place a blank card on the number line. Have students work together to determine what number (multiple of 10) goes on the blank card.



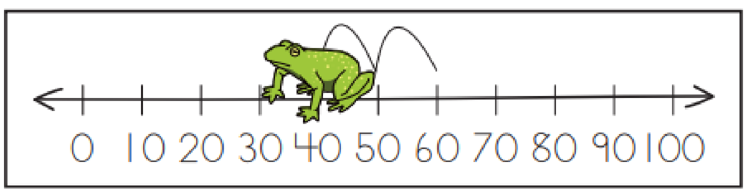
Students will use a number line to model addition and subtraction of multiples of 10 up to 100:
Using a number line numbered 0 to 100, students will model story problems about Little Frog on the number line and record the accompanying addition and subtraction equations.

One day, Little Frog woke up on the 0. Suddenly, he realized he was late to go swimming with his friends. He made 4 hops up to the 40—let's count the 10s together—10, 20, 30, 40, but he didn't see his friends anywhere. So, he made 2 more hops—ready to count—10, 20. Where did he land? Right, he's on the 60 now.



40 + 20 = 60

Little Frog helps us see that 40 + 20 is 60, but he didn't find his friends. He could hear them having fun in the water, so he turned around and went 2 hops, or 20, back the other way. Where do you think he's going to land?



40 + 20 = 60

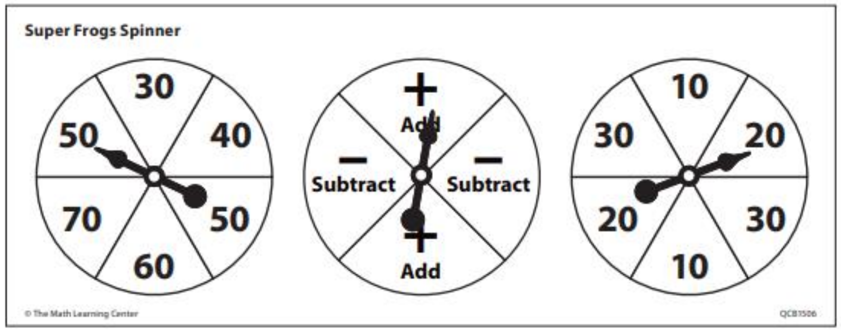
60 – 20 = 40

Students will practice adding or subtracting multiples of 10 by playing the *Super Frogs* game:

Teams each take a turn spinning three spinners to create an addition or subtraction expression and hopping their frog along the number line to match the expression. The team with the greater sum or difference (the one whose frog lands farthest along the line) scores a point (a Unifix cube). The winner is the first team to get five points.

Take the first turn to spin the three parts of the Super Frogs Spinner to create an expression.

Have students read the expression on the spinner after you've made the three spins.



Teacher *You can see what I spun on all three spinners. What does it say?*

Students *Fifty plus 20.*

Tell a story to match the expression as you move your frog along the number line.

As you tell the story and move the frog along the line, engage students in discussion about the apparent contradiction between the number of hops and the numbers on the rocks. How can the little frog reach 50 in only 5 hops and in just 2 more hops land on the 70?

Week Three: Week 3 continues to develop students' conceptual understanding of our number system through explorations with open and closed number lines. In particular, it focuses on skip-jumps along the number line in multiples of 5 and 10. Students have fun guiding frogs that hop over stones and lily pads, racing along number lines both forward and backward in distances of 1, 5, and 10, and develop confidence adding and subtracting in multiples of 5 and 10 both on and off the decade. The final session includes the Unit 4 assessment.

Students will practice counting forwards and backwards by 10 by moving a frog along lily pads:
Using the life-sized number line from the previous weeks, hang the multiple of 10 lily pad number cards numbered 0 to 100. Next, introduce the two frog cards, and the one fly card. As students watch, place the larger of the two frogs (Tad) on card 20, and the smaller of the two (Polli) on card 80. Place the fly on 50.

Give students a few moments to examine the display quietly. Then ask them to share, first in pairs and then as a whole group, any observations they can make.

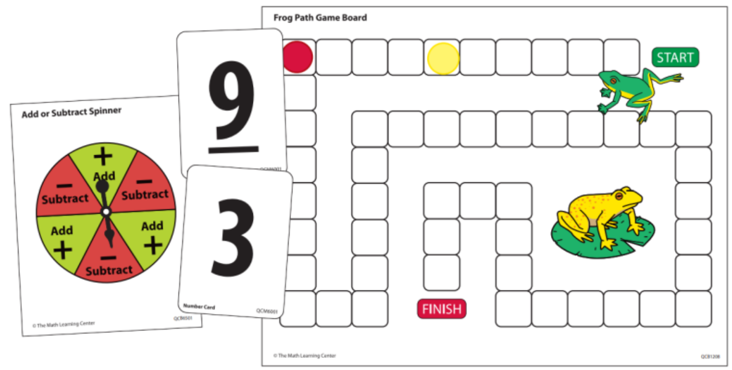
Students *Tad is on the 20!*
Polli is on 80. She's farther ahead.
She's almost up to 100.
That fly is on the 50.
I think the fly is right in the middle of the two frogs.

If students haven't already addressed this in their observations, have them tell which numbers Tad, Polli, and the fly are sitting on. Then pose and discuss the following problems with the class.

- Which frog needs to jump backward down the line toward 0 to get to the fly? (Polli)
- How many jumps will it take for each frog to get to the fly? (3 jumps)
- If the frogs jump at the same time, which one will get to the fly first? (They'll get there at the same time.)

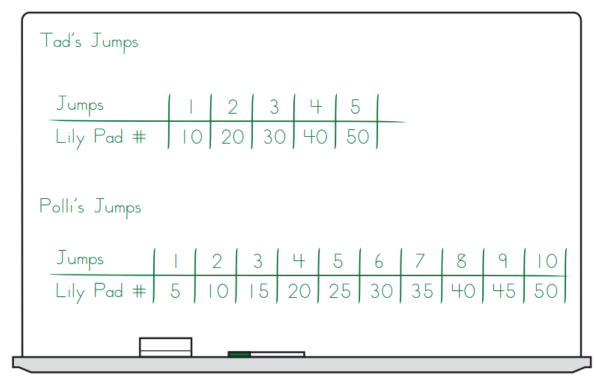
Students will practice addition and subtraction to 10 playing the *Frog Path* game:

Players take turns drawing two Number Cards, spinning the Add or Subtract Spinner, and forming a combination with them. They figure out the sum or difference and move that number of spaces on the Frog Path Game Board. The first player to reach the finish box is the winner. Players do not have to land exactly on the last box.



Students will practice counting forwards and backwards by 5 by moving a frog along lily pads:
Replace the multiple of 10 lily pad cards with the multiple of 5 cards. Next, place the two frog cards on the 0 card. Place the fly card on 50. Explain that Tad jumps by 10s (10, 20, 30, 40, and so on) and Polli jumps by 5s (5, 10, 15, 20, 25, 30, and so on) today. Ask students to predict, first in pairs and then as a whole class, how many jumps will it take each frog to reach the fly.

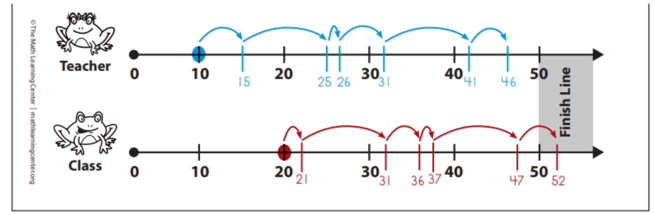
As students watch, move Tad down the number line, landing on each multiple of 10 as you go until he’s on the lily pad numbered 50. Then put Tad back on the 0 and divide the class in half. Have half the class count each jump by 1s; have the other half count each jump by 10s as you hop Tad back up the line to 50 again. After Tad reaches 50, place the card back on 0. Then ask a student to hop Tad down the line by 10s one more time, as you work with students to record each move in a ratio table similar to the one shown in the illustration. Repeat with Polli, hopping her down the line by 5s instead of 10s.

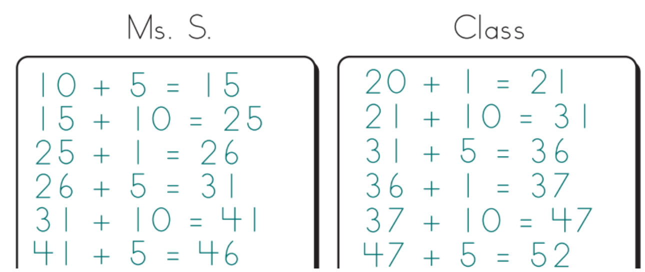


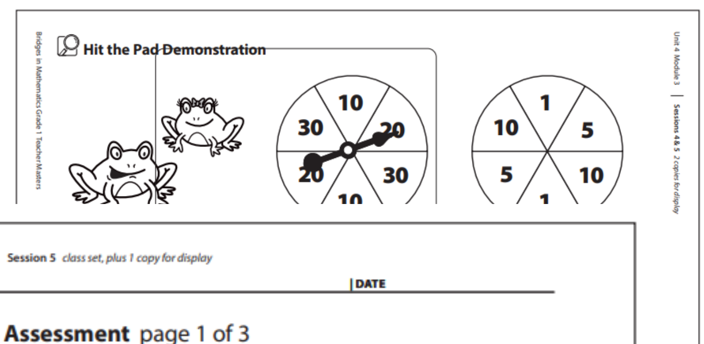
Students will count and add by 1s, 5s and 10s playing the *Frog Race* game:
Teams take turns spinning the spinner labeled Start, and putting a mark on their

number line to show where their frog gets to start. (One frog might get a head start, depending on where the spinner lands.) Then the teams take turns spinning the Hop spinner and marking the line to show how far they hopped and what number they landed on each time. The first team to get their frog across the finish line at 50 wins the game.

Take time after each team's turn to write a new equation representing the move—you are recording on the board and the students on their whiteboards. (Depending on the needs and strengths of your class, you might, after the first 2 or 3 turns, have students write and solve the equation after they spin, but before they make the hop and label the new location on their line.)

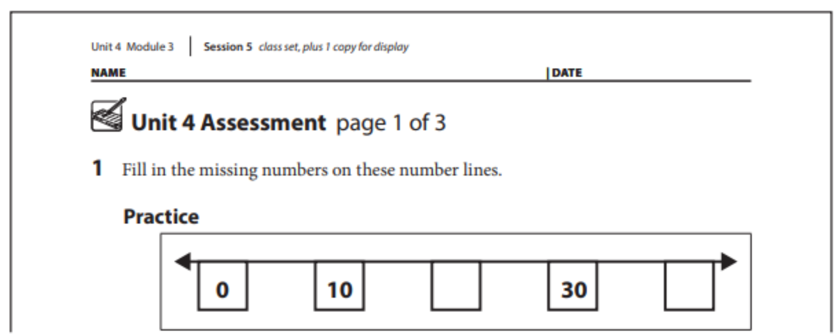






Students will count, add and subtract by 1s, 5s and 10s playing the *Hit the Pad* game:
Two frogs are each looking for a magic lily pad somewhere between 0 and 40 on their path. To start, each team spins the Lily Pad Decade Spinner and rolls a die to find out where their magic lily pad is. When they find out, they mark and label that special spot on their path. Then they take turns spinning the Hop Spinner and making hops on their line to reach the magic lily pad. In order to reach their magic pad, they can hop past it and then take hops back. They can even decide not to hop at all if a number they spin won't help them reach their lily pad. The first frog to land exactly on his or her magic pad wins the game.

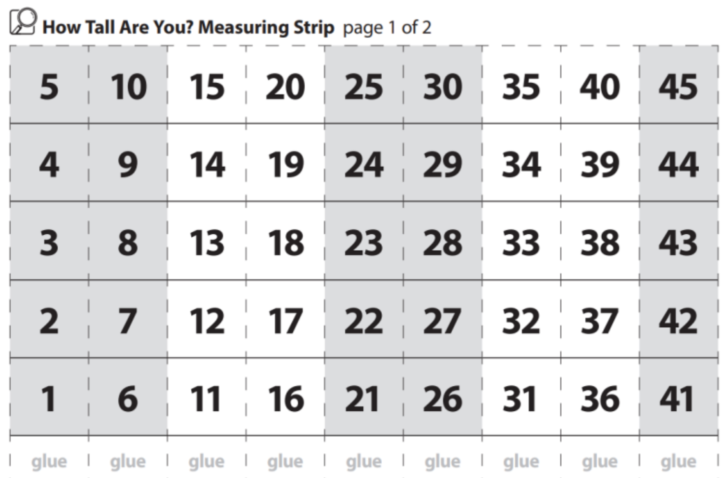
Administer Unit 4 Assessment:



Complete practice problems and review together. Read directions aloud and allow students to work independently.

Week Four: The mathematical focus of Week 4 is measurement, comparing and ordering two-digit numbers, writing inequality statements, finding differences, and working on a number line. In the context of a pretend trip to Antarctica, students get their heights measured for snowsuits and graph the results. The class records height and other data for two types of penguins: the rockhopper and the king. Students make measuring strips and strings and use them to order and compare the numbers and find differences.

Students will practice counting to 70 while making their own measuring strips:



How Tall Are You? Measuring Strip page 1 of 2

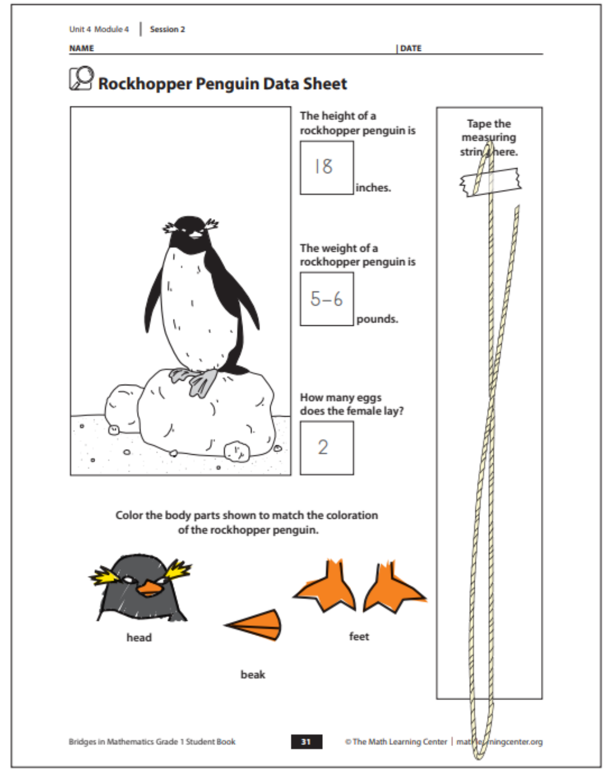
5	10	15	20	25	30	35	40	45
4	9	14	19	24	29	34	39	44
3	8	13	18	23	28	33	38	43
2	7	12	17	22	27	32	37	42
1	6	11	16	21	26	31	36	41
glue	glue	glue	glue	glue	glue	glue	glue	glue

Students will measure the height of a rockhopper penguin and compare it with their own height:

Explain to students that today they'll learn about this penguin, the rockhopper, and they will compare their own height with that of the bird. Display the Rockhopper Penguin Data Sheet Student Book page, and have students find the corresponding sheet in their own books. Ask students to consider how a rockhopper penguin's height compares with theirs, and to use their measuring strips to find out for sure.

Ask students to estimate with their hands how tall they think a rockhopper penguin is (from the floor up). Have them check their How Tall Are You? Measuring Strips to find out for sure. If they were standing beside a rockhopper, where would the top of its head reach compared to themselves—their knees, their waist, their shoulders?

Demonstrate how students should work in pairs to use their strips to measure a piece of string as tall as a rockhopper—18 inches—and then cut and tape it onto the Rockhopper Data Student Book sheet. Hand out lengths of string, and as students work, circulate and help, checking their measurements before they cut. Have them tape their strings onto their Rockhopper Penguin Data Sheet in their Student Books.



Unit 4 Module 4 | Session 2

NAME | DATE

Rockhopper Penguin Data Sheet

The height of a rockhopper penguin is 18 inches.

The weight of a rockhopper penguin is 5–6 pounds.

How many eggs does the female lay? 2

Tape the measuring string here.

Color the body parts shown to match the coloration of the rockhopper penguin.

head

beak

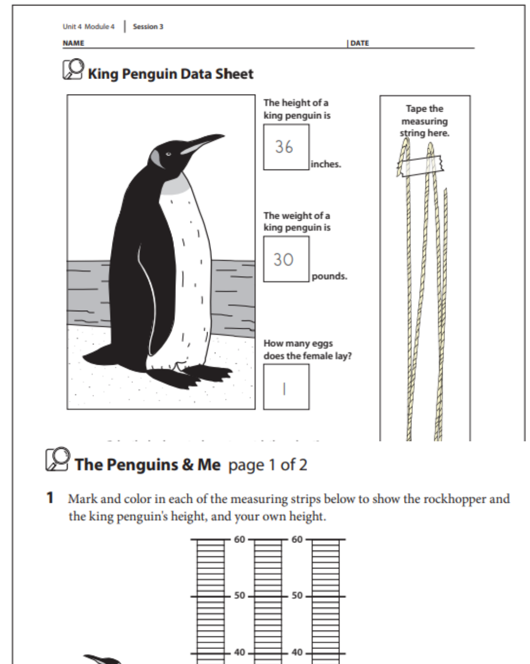
feet

Bridges in Mathematics Grade 1 Student Book 31 © The Math Learning Center | mathlearningcenter.org

Students will measure the height of a king penguin and compare it with a rockhopper penguin and their own height:
Explain to students that today they'll learn about this penguin, the king penguin, and they will compare their own height with that of the bird. Display the King Penguin Data Sheet Student Book page, and have students find the corresponding sheet in their own books. Ask students to consider how a king penguin's height compares with theirs, and to use their measuring strips to find out for sure.

Ask students to estimate with their hands how tall they think a king penguin is (from the floor up). Have them check their How Tall Are You? Measuring Strips to find out for sure. If they were standing beside a king penguin, where would the top of its head reach compared to themselves—their knees, their waist, their shoulders?

Demonstrate how students should work in pairs to use their strips to measure a piece of string as tall as a king penguin —36 inches—and then cut and tape it onto the King Penguin Data Student Book sheet. Hand out lengths of string, and as students work, circulate and help, checking their measurements before they cut. Have them tape their strings onto their King Penguin Data Sheet in their Student Books.


Unit 4 Module 4 | Session 3

NAME | DATE

King Penguin Data Sheet

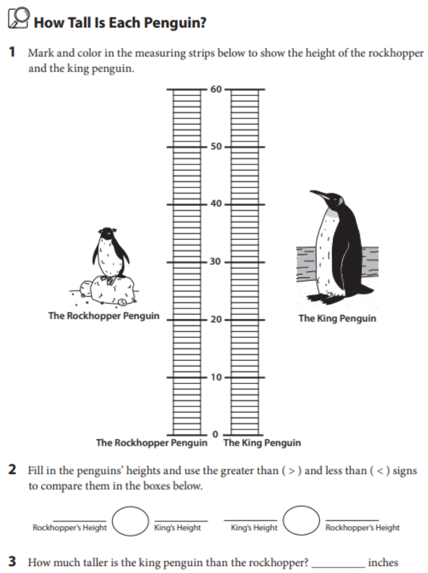
The height of a king penguin is 36 inches.

The weight of a king penguin is 30 pounds.

How many eggs does the female lay? 1

Tape the measuring string here.

Students compare the heights of the rockhopper penguin and king penguin and write corresponding inequality statements:

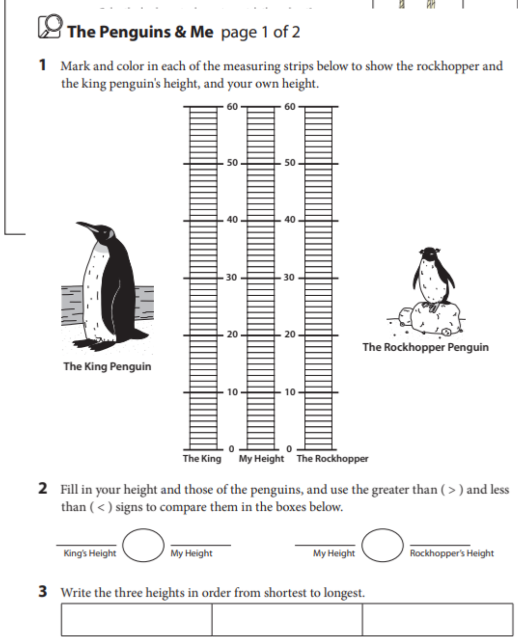

How Tall Is Each Penguin?

1 Mark and color in the measuring strips below to show the height of the rockhopper and the king penguin.

2 Fill in the penguins' heights and use the greater than (>) and less than (<) signs to compare them in the boxes below.

Rockhopper's Height ◯ King's Height   King's Height ◯ Rockhopper's Height

3 How much taller is the king penguin than the rockhopper? _________ inches


The Penguins & Me page 1 of 2

1 Mark and color in each of the measuring strips below to show the rockhopper and the king penguin's height, and your own height.

2 Fill in your height and those of the penguins, and use the greater than (>) and less than (<) signs to compare them in the boxes below.

King's Height ◯ My Height   My Height ◯ Rockhopper's Height

3 Write the three heights in order from shortest to longest.

Students compare the heights of the rockhopper penguin and king penguin to their own heights and write corresponding inequality statements.

Interdisciplinary / Real World / Global Connections

- Counting by 5s and 10s is applied when using nickels and dimes or $5 and $10 bills.
- Measuring length is used in the home and in a variety of careers.
- Addition helps kids master the relationships between numbers and understand how quantities relate to one another.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively
☐ Writing effectively for a variety of purposes
☐ Presenting ideas accurately with the support of engaging media
☒ Thinking critically to solve problems and reach well-reasoned judgments
☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall

- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

English Language Learners (ELL):

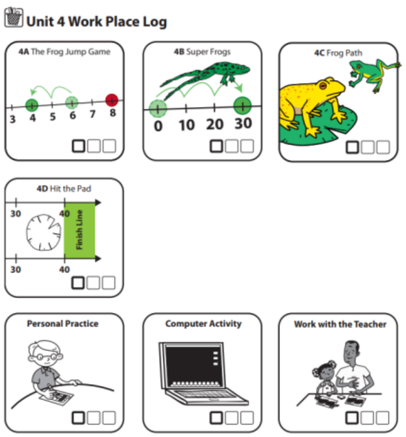
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 4 Numbers on a Line Checkpoint

Numbers on a Line Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name																	
1a–d Uses doubling and halving relationships to determine and fill in the missing numbers on a set of open number lines. *10, 50, 15, 10, 30, 40*	Supports 1.OA 1.NBT.5	**6 pts.** • 1 pt. for each correct answer																		
2 Counts forward by 1s within 120 from starting points other than 0 or 1 *a) 16, 19, 20, 23* *b) 39, 40, 41, 44* *c) 100, 101, 105, 108* *d) 111, 114, 117, 120*	1.NBT.1	**8 pts.** • 2 pts. for entering all 4 missing numbers in a sequence correctly, OR • 1 pt. for entering 2 or 3 of the missing numbers in a sequence correctly																		
3 Adds 1-digit to 1-digit numbers, and 2-digit to 2-digit numbers, using a closed number line to model and solve each combination *9, 10, 70*	Supports 1.OA 1.NBT.4	**6 pts.** (2 pts. per problem) • 1 pt. for the correct answer • 1 pt. for modeling the combination accurately on the number line (e.g. starting at 0 and either hopping by 1s or making one long jump to reach the first addend, and then hopping by 1s from there, as specified by the second addend, to reach the total)																		
4 Subtracts 1-digit from 1-digit numbers, and 2-digit from 2-digit numbers, using a closed number line to model and solve each combination	Supports 1.OA 1.NBT.6	**6 pts.** (2 pts. per problem) • 1 pt. for the correct answer • 1 pt. for modeling the combination accurately on the number line e.g., starting at the minuend along the line and																		

- Unit 4 Post-Assessment

Unit 4 Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name																	
1a–c Counts by 10s and uses doubling and halving relationships to determine and fill in the missing numbers on a set of open number lines. *a) 40, 60* *b) 70, 80, 100* *c) 40*	Supports 1.OA 1.NBT.1 1.NBT.5	**6 pts.** • 1 pt. for each correct answer																		
2 Counts forward by 10s off the decade (e.g., from numbers other than multiples of 10) *a) 24, 44, 54, 94* *b) 17, 47, 67, 97)*	Supports 1.OA 1.NBT.1 1.NBT.5	**4 pts.** • 2 pts. for entering all 4 missing numbers in a sequence correctly, OR • 1 pt. for entering 2 or 3 of the missing numbers in a sequence correctly																		
3 Counts backward by 10s off the decade (e.g., from numbers other than multiples of 10) *a) 78, 58, 18* *b) 76, 66, 46, 6*	Supports 1.OA 1.NBT.1 1.NBT.5	**4 pts.** • 2 pts. for entering all 4 missing numbers in a sequence correctly, OR • 1 pt. for entering 2 or 3 of the missing numbers in a sequence correctly																		
4 Adds 1-digit to 1-digit numbers, and 2-digit to 2-digit numbers, using a closed number line to model and solve each combination *7, 90*	Supports 1.OA 1.NBT.4	**4 pts.** (2 pts. per problem) • 1 pt. for the correct answer • 1 pt. for modeling the combination accurately on the number line (e.g., starting at 0 and either hopping by 1s or making one long jump to reach the first addend, and then hopping by 1s from there, as specified by the second addend, to reach the total)																		
		Subtotal page 1																		

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 5: Geometry
Pacing	4 Weeks

CT State Standards
What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
1.MD.4 Organize, represent, and interpret data with up to 3 categories
1.G.1 Demonstrate an understanding of the difference between the defining and non-defining attributes of a 2-D shape
1.G.1 Demonstrate an understanding of the difference between the defining and non-defining attributes of a 3-D shape

1.G.1 Draw a 2-D shape with specific defining attributes
1.G.1 Build a 3-D shape with specific defining attributes
1.G.2 Create a composite shape by composing 2-D shapes
1.G.2 Create a composite shape by composing 3-D shapes
1.G.2 Compose a new shape using composite 2-D shapes
1.G.2 Compose a new shape using composite 3-D shapes
1.G.3 Partition a circle [rectangle] into 2 or 4 equal parts
1.G.3 Use the terms halves and half of to talk about the 2 equal parts into which a circle [rectangle] has been partitioned
1.G.3 Use the terms fourths, quarters, fourth of, and quarter of to talk about the 4 equal parts into which a circle [rectangle] has been partitioned
1.G.3 Describe a whole circle [rectangle] as 2 [4] of two [four] equal parts
1.G.3 Demonstrate an understanding that as a shape is partitioned into a greater number of equal parts (e.g., 4 equal parts rather than 2), the size of the parts gets smaller

Supporting Standards:
1.G Identify, name, describe, and compare 2-D shapes, including circles, triangles, rectangles, squares, rhombuses, hexagons, and trapezoids
1.G Identify, name, describe, and compare 3-D shapes, including cubes, rectangular prisms, triangular prisms, pyramids, cylinders, cones, and spheres

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Identify, name, and describe 2D shapes. 2. Compare 2D shapes. 3. Identify, name, and describe 3D shapes. 4. Compare 3D shapes. 5. Draw 2D shapes.	1. 2D shapes are flat with length and width. 2. 2D shapes can be categorized by number of sides/angles, length of sides, and orientation of sides to each other. 3. 3D shapes are solid with length, width, and depth. 4. 3D shapes can be categorized by number of faces, length of edges, and orientation of edges and angles to each

6. Draw 3D shapes. 7. Use two or more shapes to create a new shape. 8. Split whole shapes into halves, thirds and fourths.	other. 5. 2D and 3D shapes can be combined to make additional shapes. 6. A fraction is some number or equal parts of a whole.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What everyday shapes do you see around you? 2. How can you build and draw shapes with specific features? 3. How can you combine shapes to make new shapes? 4. How can you divide a shape into equal parts?	1. The physical world is made of shapes. 2. Shapes are categorized by attributes such as number of sides/edges/angles, length of sides/edges, orientation of sides/edges. 3. Shapes can be combined and modified to make different shapes. 4. Shapes can be divided in fractions, which are equal parts of a whole.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

When using Tech-Enhanced Activities (TEAs), the following standard will be used.

Standard 1.5.b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Informational Texts:

- **Informational Books:**
  - Shapes, Shapes, Shapes
  - So Many Circles, So Many Squares
  - The Greedy Triangle

- Captain Invincible and the Space Shapes
    - Cubes, Cones, Cylinders and Spheres
    - Mummy Math
    - Eating Fractions
- **Media:**
    - 3D Shapes Rap!

MLC Apps:

- Pattern Shapes App
- Geometry Shapes Game
- Patch Tool
- Cube Nets Activity
- Shapes Game
- Fractions App
- Geoboard App

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:
Add: to combine; to put together two or more quantities.
Attribute: a characteristic such as color, shape, size, etc.
Circle: a two-dimensional (flat) shape made by drawing a curve that is always the same distance from a point called the center.
Compare: to examine to note similarities and differences; to determine whether numbers are greater than, less than, or equal.
Cone: a three-dimensional shape (solid) with a circular or elliptical base and a curved surface that tapers to the vertex.
Cube: a three-dimensional shape (solid) whose 6 faces are all squares.
Cylinder: a three-dimensional shape (solid) with one curved surface and two congruent flat ends that are circular or elliptical.
Edge: the line segment along which 2 faces of a three-dimensional shape (solid) meet.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Face: a flat surface of a three-dimensional shape (solid).
Fourth: one part when a number, shape, or set is divided into exactly four equal parts; also called a quarter.
Fraction: a number expressed as some number of equal parts of a whole.

Half: one part when a number, shape, or set is divided into exactly two equal parts.
Hexagon: a two-dimensional (flat) shape with 6 sides,
Pyramid: a three-dimensional shape (solid) that has a base with 3 or more sides and has triangular faces that meet at a point.
Rectangle: a two-dimensional (flat) shape with 2 pairs of parallel sides (4 sides total) and 4 right angles.
Rectangular Prism: a three-dimensional shape (solid) whose 6 faces are all rectangles.
Rhombus: a two-dimensional (flat) shape with 4 congruent sides.
Side: a line segment that, with other line segments, forms a two-dimensional (flat) shape.
Sphere: a three-dimensional shape (solid) constructed so that every point of the surface is the same distance from a point called the center.
Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles.
Third: one part when a number, shape, or set is divided into exactly three equal parts.
Three-dimensional (3-D) shape: a solid shape with depth, width, and height; a shape that has volume.
Trapezoid: a two-dimensional (flat) shape with 4 sides, exactly 1 pair of which are parallel.
Triangle: a two-dimensional (flat) shape with 3 sides.
Triangular Prism: a three-dimensional shape (solid) with 2 triangular bases and 3 rectangular faces.
Two-dimensional (2-D) shape: a flat shape with length and width; a shape that has area but not volume.
Vertex or Corner: the point at which the sides of a two-dimensional (flat) shape or the edges of a three-dimensional shape (solid) intersect.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Over the course of this unit, students use a variety of tools and models to explore two- and three-dimensional shapes and fractions (halves, thirds, and fourths). Throughout, the emphasis is squarely on shapes—identifying, describing, constructing, drawing, comparing, composing, and sorting them. Students learn about fractions in the context of two-dimensional shapes as they cut paper sandwiches in halves and fourths, fold and cut paper circle pizzas to share, and play a fraction bingo game in which they must complete the pictures and labels on their own boards.

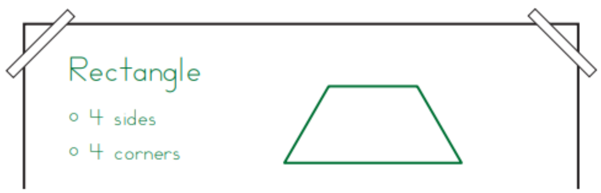
Week One: Week 1 focuses completely on two-dimensional shapes, particularly those found in the pattern blocks (triangles, trapezoids, squares, hexagons, and rhombuses), plus rectangles. The work with shapes includes comparing, distinguishing defining attributes from non-defining, and developing problem-solving strategies. Students use pattern blocks to create composite shapes and solve puzzles, and practice drawing the shapes each day.

Students identify the attributes of a rectangle:
Ask students how to draw a rectangle. Follow their directions on chart paper for everyone to see. Revise the drawings until a rectangle is correctly drawn.

Teacher *I am going to follow your instructions to draw a rectangle here on our easel. Who would like to tell me something about a rectangle that would help me draw it?*

Student A *It has 4 sides and 4 corners.*

Teacher *Like this?*



Student A *That's not a rectangle?*

Teacher *But you said a rectangle has 4 sides and 4 corners. Doesn't my shape have 4 sides and 4 corners?*

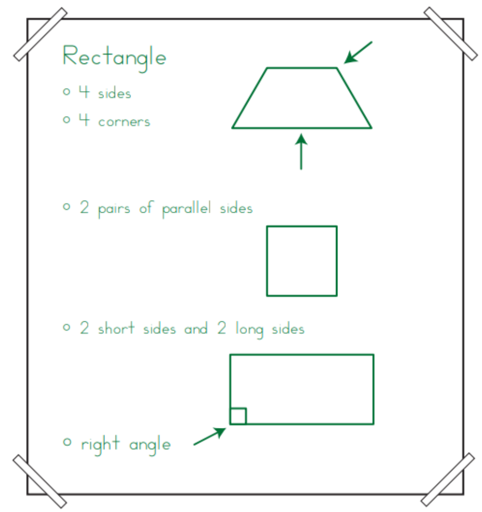
Students *But they have to be straight, not slanted like that! They have to be across from each other, like this.* (Shows parallel lines with hands.)

Teacher *Oh, you mean the sides have to be parallel. But the top and bottom sides on my shape are across from each other; they're parallel, see?*

Students *No! That's a square! On a rectangle, you have to have 2 short sides and 2 long sides. But the corners are square like that.*

Teacher *Oh, so if I'm going to draw a rectangle, I need 2 long straight parallel lines like this and 2 shorter ones like this? And I need to be sure that I draw it with square—or right—angles? Like this?*

Students *Yes! You should cross out those others. They're not rectangles!*



Students will discuss the attributes of 2D shapes and draw them during a guessing game called *What's In the Box?*:

Show students your closed box or sack. Tell them you have a collection of shape cards in the box and that the game will give them a chance to find out more about these cards. Let them know you will play until they guess every card in your box. Then invite students to guess the shapes you have in the box. Model the language of geometry as you help them narrow the range of possibilities. Explain that each time they guess a new type of shape, you will display the card and they will draw it.

Teacher *Does someone have another guess?*

Student *Do you have a diamond?*

Teacher *Do you mean a shape like the blue rhombus in our set of pattern blocks?*

Student *Yes, that kind.*

Teacher (Looking into the box again) *You know, I don't have any rhombuses, but I do have a shape that matches one of the other pattern blocks in our set.*

Student *Oooh! I bet it's that big yellow one—what's it called? A hexagon! Do you have a hexagon in your box?*

Teacher *As a matter of fact, I do. Here it is.*

Students identify the attributes of a Triangle:

Ask students how to draw a triangle. Follow their directions on chart paper for everyone to see. Revise the drawings until a triangle is correctly drawn.

Teacher *Let's do another shape drawing warm-up today. Close your eyes and picture a triangle. OK, now describe that shape to the person sitting next to you.* (Gives students a minute to pair-share.)

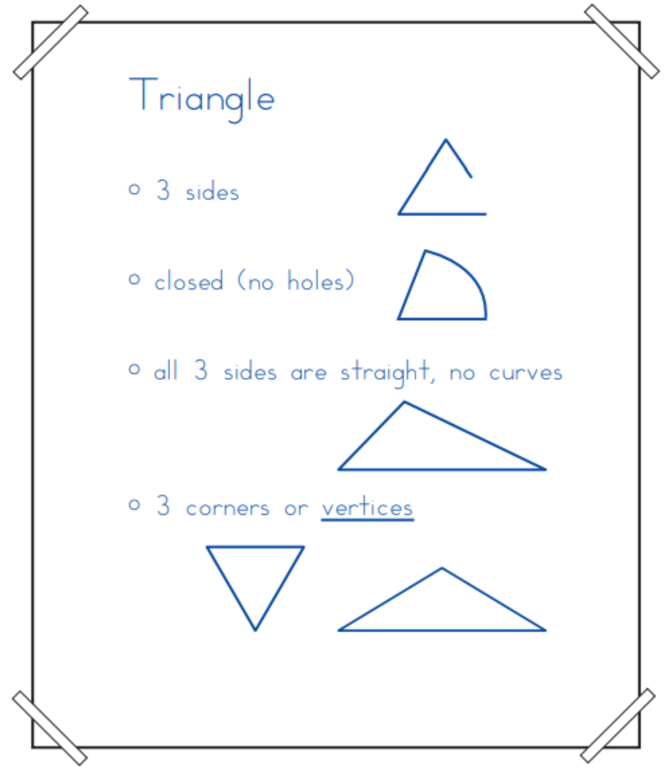
Teacher *I am going to follow your instructions to draw a rectangle here on our easel. Who would like to tell me something about a triangle that would help me draw it?*

Students *It looks like a mountain.*
It has 3 sides.

Teacher *Like this?*

Students *No! There can't be any holes!*
You have to make it so all the sides hook together.

Teacher *I think I've got it. A triangle has 3 straight sides, it has to be closed, and it has 3 corners or vertices. Are the shapes I've drawn here at the bottom of the sheet OK? Are they triangles? Talk with the person next to you, and then I'll call on a few people to share their thinking with the class.*



Students identify the defining attributes of 2D shapes by sorting shape cards:
Hand out one 2-D Shape Card to each student and have them identify their shape to a neighbor. Explain that, on your signal to start, you'd like them to get up and find other students who are holding a shape that's the same color (red, yellow, green) as theirs. When they find each other, they should stand together. Next, have students rearrange themselves by shape (rectangle, triangle, trapezoid, and hexagon) and identify their shape. Then ask students to rearrange themselves by shape and size (e.g., small circles, large

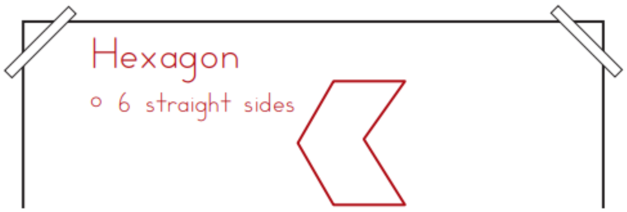
rectangles, and so on), and have them identify their shape and size. Take a moment to discuss which attributes define a shape and which do not. A defining attribute is one of a set that characterizes a particular shape. For example, the property of being four-sided is a defining attribute of a rectangle but being green or large is not.

Students identify the attributes of a Hexagon:

Ask students how to draw a hexagon. Follow their directions on chart paper for everyone to see. Revise the drawings until a hexagon is correctly drawn.

Teacher *I am going to follow your instructions to draw a hexagon here on our easel. Who would like to tell me something about a trapezoid that would help me draw it?*

Students *It looks kind of like a stop sign. It has 6 sides. Make them straight!*

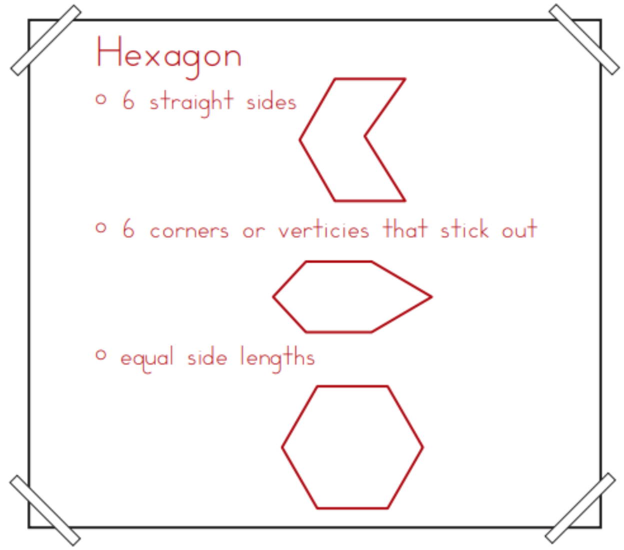


Teacher *How's this?*

Students *That doesn't look like a hexagon. It looks kind of like an arrow!*

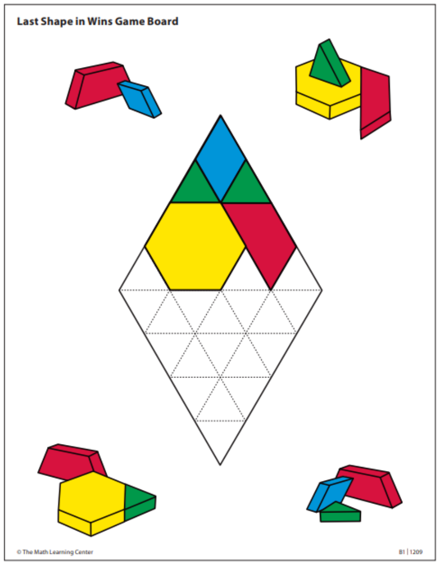
Teacher *Take a good look at the shape I've drawn. Does it have 6 straight sides? Let's count, ready?*

Student A *But it doesn't look like this hexagon, the one from the pattern blocks!*



Note Actually, all of the shapes on the teacher's chart are hexagons because they're all 6-sided, closed figures. However, most first graders, if they have had any experience with hexagons at all, are familiar only with the regular hexagon, which has 6 equal sides and 6 angles that each measure 120º. In later grades, they will learn that any 6-sided, closed figure is called a hexagon.

Students familiarize themselves with triangles, rhombuses, trapezoids, and hexagons by using Pattern Blocks in a game called *Last Shape in Wins*:
Players take turns placing pattern blocks on a large rhombus, using the lines on the board to help position the blocks accurately. On each turn, players place one shape—a triangle, a trapezoid, a blue rhombus, or a hexagon. Each new shape needs to touch a side or vertex of at least one other shape already on the board. The player who can place the block that completes the large rhombus wins.



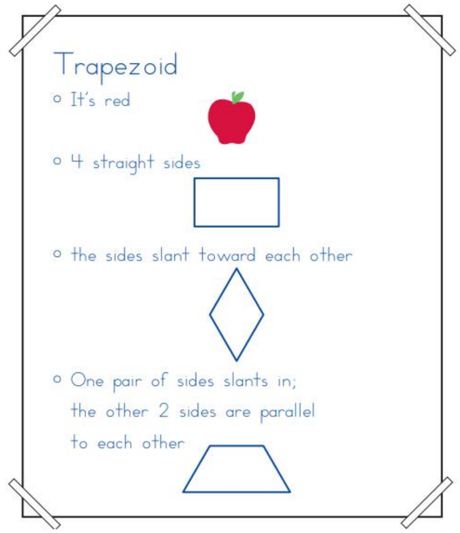
Students identify the attributes of a Trapezoid:
Ask students how to draw a Trapezoid. Follow their directions on chart paper for everyone to see. Revise the drawings until a trapezoid is correctly drawn.

Students *No!*
That's a rectangle!

Teacher *But you said it had to have 4 straight sides. Doesn't this shape have 4 straight sides?*

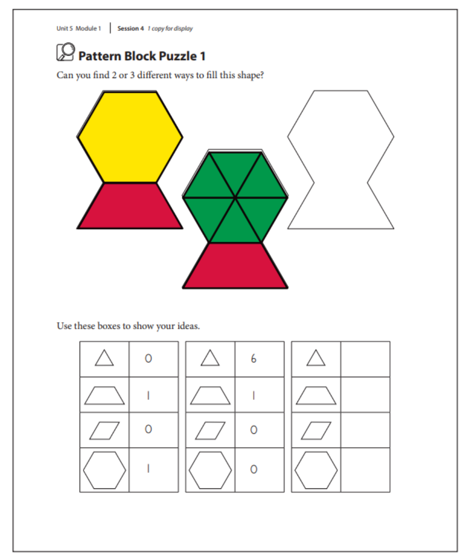
Student *But the sides are slanty—they slant together.*

Teacher *Oh, OK! How 'bout this?*



Students *Yay! She got it right!*
That's a trapezoid.

Students practice with triangles, rhombuses, trapezoids, and hexagons by using Pattern Blocks by solving *Pattern Block Puzzles*:
Explain that this is a puzzle that can be solved in many ways. The idea is to use pattern blocks to fill the top shapes completely and then use the boxes at the bottom of the sheet to show how you did it.



Students identify the attributes of a Rhombus:

Ask students how to draw a Rhombus. Follow their directions on chart paper for everyone to see. Revise the drawings until a rhombus is correctly drawn.

Teacher *I am going to follow your instructions to draw a rhombus here on our easel. Who would like to tell me something about a rhombus that would help me draw it?*

Student *It's blue!*

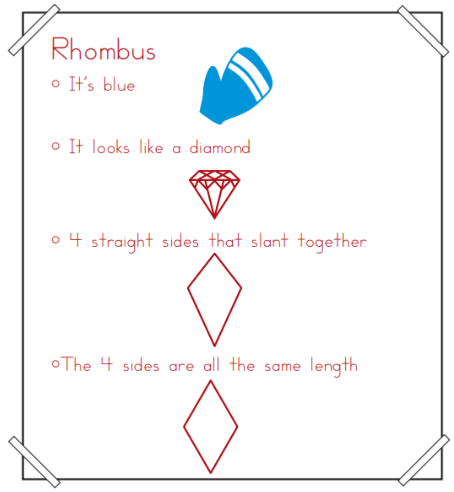
Teacher *Like this?*

Students *That's not a rhombus! That's not even a shape!*

Teacher *Is there anything else you can tell me about the rhombus you're holding that will help me draw it more accurately?*

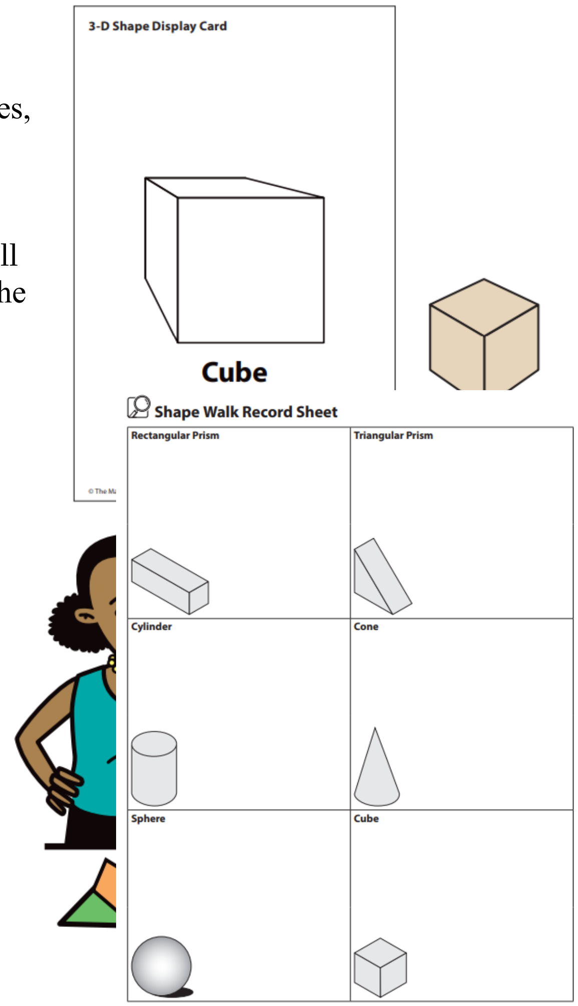
Student *All the sides are the same.*

Teacher *Oh, OK. Let me try again. How's this?*



Week Two: In Week 2 the attention turns to three-dimensional shapes, particularly cubes, rectangular prisms, cones, cylinders, spheres, triangular prisms, and pyramids. Students identify, name, describe, and compare the shapes, locate them in their environment, and sort them by attributes. Later sessions introduce students to nets, flat arrangements of squares and triangles that can be formed into cubes and square pyramids.

Students explore 3D shapes (cube, rectangular prism, triangular prism, cone, sphere, cylinder, pyramid):
Let students know that the class will be exploring three-dimensional shapes over the next few days. Today, you will show them examples of some three-dimensional shapes, and then they will get to be detectives and look for more examples of these shapes around the room. Hold up each of the 3-D Shape Cards one by one, along with the corresponding geoblock as you name the shape, and invite observations from the students. As you talk with students about each of the shapes, reinforce its name as well as the fact that these are three-dimensional or solid shapes, even though the faces of the polyhedrons (cube, rectangular prism, triangular prism, and pyramid) are two-dimensional.



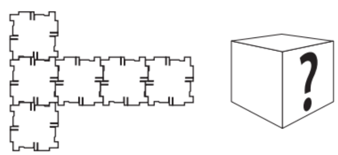
Students will sort 3D shapes by their attributes:
The teacher pulls a collection of three-dimensional objects out of a bag, placing all those with flat faces in one group and all those with curved surfaces in another. Students predict where new objects belong as they try to guess the teacher's sorting rule.

Students will look for examples of 3D shapes when going on a *Shape Walk:*
After a discussion about the possibility of seeing cubes, rectangular prisms, triangular prisms, cones, spheres, and cylinders, students hunt for three-dimensional shapes in the gym, library, or on a walk around the school, keeping a record of their discoveries as they go on the Shape Walk Record Sheet. Upon return to the classroom, they discuss their findings.

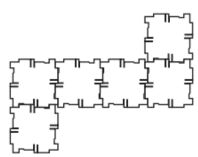
Students will create cubes using Polydrons:
Distribute containers of Polydron squares. Have individuals or pairs of students use the Polydrons to make a cube and determine for sure the number of squares it takes. Once students have determined that a cube has 6 faces, ask them if they think 6 Polydron squares can always be folded to make a cube, no matter how they're connected in the beginning.

Will It Make a Cube?

1 Snap 6 Polydron squares into the arrangement shown below. If you fold them up and snap them together, do they make a cube?



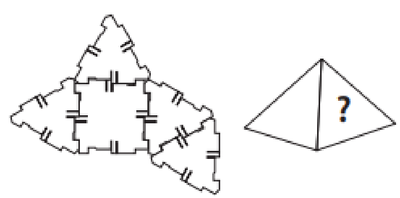
2 What about this arrangement? Will it make a cube? Predict first and then try it. Circle Yes or No to show what actually happened.

Prediction	Yes	No
		
Actual	Yes	No

Students will create Pyramids using Polydrons:
The class reviews the attributes of a pyramid and compares two types: square and triangular. Then they make and test two configurations of Polydrons to see which will fold and snap together into pyramids and which will not.

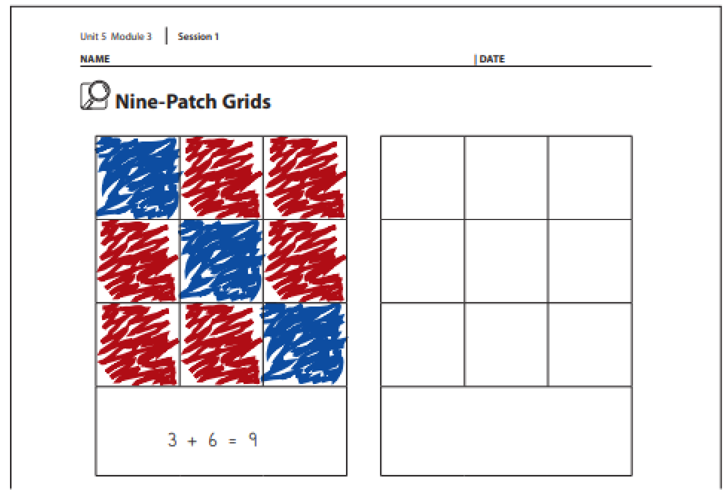
Will It Make a Pyramid?

1 Snap 4 Polydron triangles and 1 Polydron square into the arrangement shown below. If you fold these shapes up and snap them together, do they make a pyramid?



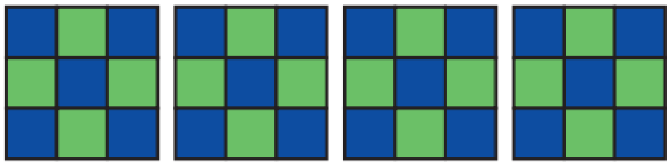
Week Three: After a project in which students create nine-patch mini-quilts by composing square quilt blocks into larger squares, the focus shifts to fractions. Students fold and cut paper to decompose shapes and play a bingo game to explore halves, fourths, and thirds.

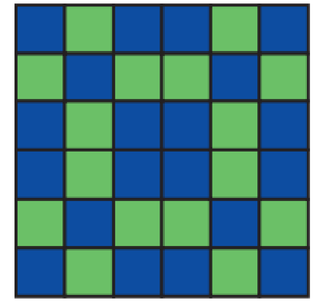
Students decompose the number Nine by designing and coloring Nine-Patch Grids:
Display a copy of the Nine-Patch Grids page and ask students to share any observations they may have. Be sure to discuss the fact that the nine small squares in each grid combine to make one larger square. Explain that each of the four large squares is a blank quilt block and that today they get to invent their own designs. Students color in some of the small squares in each grid on the Student Book page with one crayon and some squares with another, to pick two crayon colors and work neatly and carefully. For each design they create, students write an equation in the box below the grid that matches. For example, if they color 4 squares pink and 5 squares purple, they need to write 4 + 5 = 9 in the box below that grid.


Unit 5 Module 3 | Session 1
NAME | DATE
Nine-Patch Grids

Students will use the Nine-Patch Grids from the previous lesson to create quilts with or without rotational symmetry:
Students use the grids they invented during the previous session to make mini-quilts. First, they make four copies of their favorite grid. Then the teacher reconvenes the class to compare the effects of combining sets of blocks with different symmetries. Students then return to their own grids, explore the possible arrangements, and glue down the one that pleases them most.

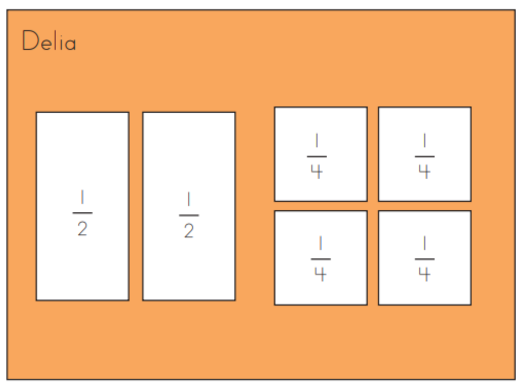
__Teacher__ Before you go to work on your own blocks, let's look at Rosa's four quilt blocks. She made the checkerboard four times. What do you think will happen when we put hers together?

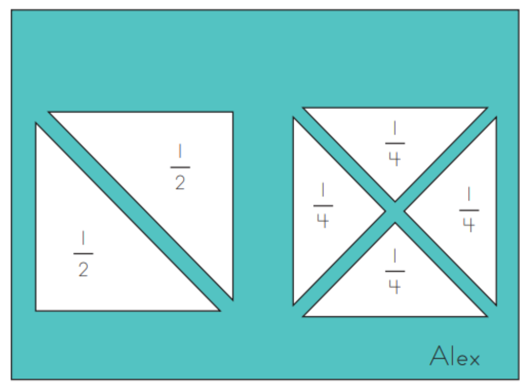




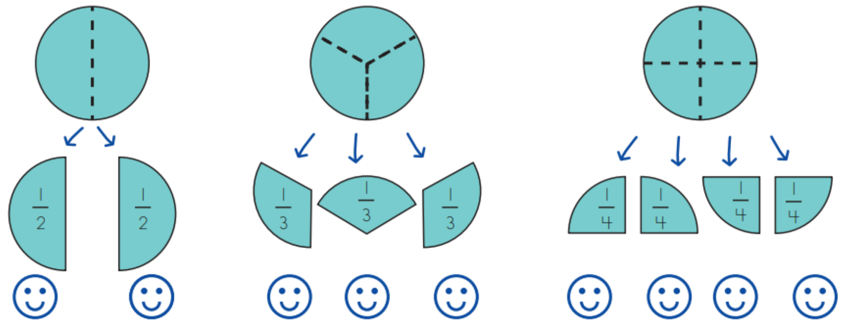
__Students__ It looks like a tic-tac-toe.
It makes me think of a big checkerboard.
It looks like adding—those plus things.

Students are introduced to one-half and one-fourth fractions by folding and cutting paper squares:
The teacher begins a story about a girl who cuts her sandwich in half. Students suggest ways for the teacher to cut a piece of paper in half and then fold their own piece of paper. The story continues and the students fold a piece of paper into fourths, cut on the fold lines, label the pieces 1/2 and 1/4, and glue them on a piece of colored paper.

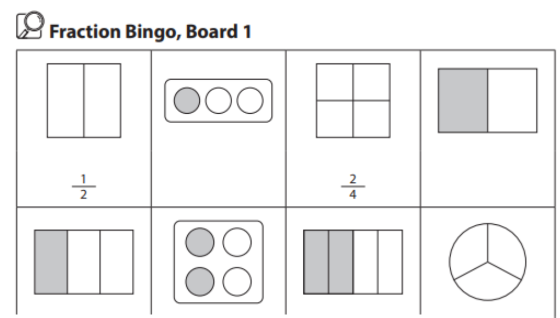


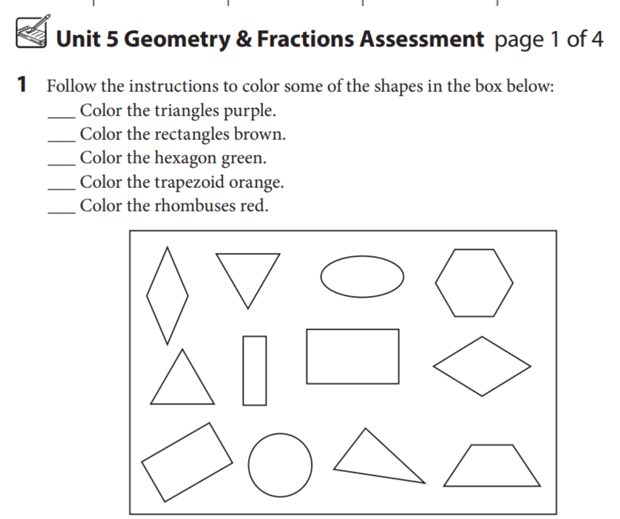


Students explore one-half, one-third and one-fourth fractions by folding and cutting paper circles:
The teacher begins a story about friends who want to share a pizza equally. Students suggest ways for the teacher to cut a piece of paper in two, three or four equal pieces and then fold their own piece of paper. The story continues and the students fold a piece of paper into halves, thirds or fourths, cut on the fold lines, label the pieces 1/2, 1/3 or 1/4, and glue them on a piece of colored paper.



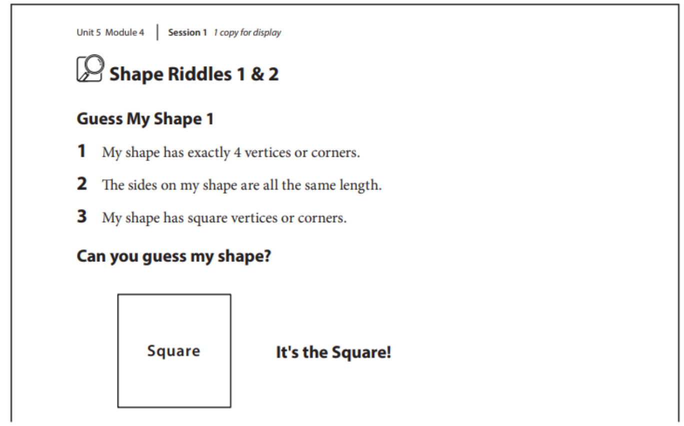
Students work with the fractions ½, ⅓ and ¼ playing *Fraction Bingo:*
Today, the teacher introduces a bingo game focused on fractions. Both the bingo cards and the bingo boards are unfinished—they are missing either the proper shading or the fraction name. Students problem-solve with the teacher to determine what's missing on each card and mark their boards by either coloring in part of a shape to match the fraction or writing the fraction name to match a picture. The first team to mark four boxes in a row wins the game.





Administer Unit 5 Assessment:
Complete practice problems and review together. Read directions aloud and allow students to work independently.

Week Four: Students synthesize some of the things they have learned about two-dimensional shapes over the past few weeks. Keying in on the defining attributes of the shapes, students sort them to solve mysteries and generate graphs. The activities in this module facilitate the development of general problem-solving skills such as brainstorming, breaking situations into smaller parts, and using the process of elimination.


Unit 5 Module 4 | Session 1 *1 copy for display*

Shape Riddles 1 & 2

Guess My Shape 1

1. My shape has exactly 4 vertices or corners.
2. The sides on my shape are all the same length.
3. My shape has square vertices or corners.

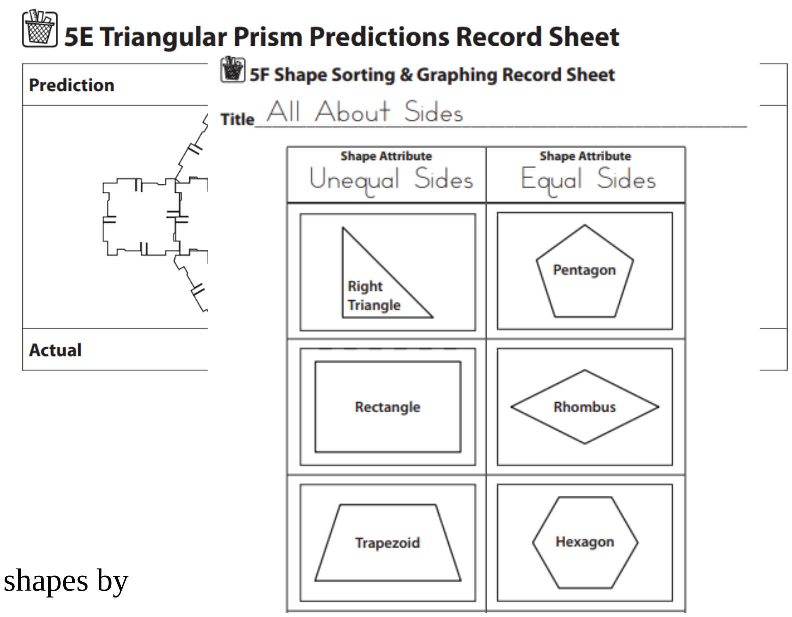
Can you guess my shape?

Square

It's the Square!

Students study the attributes of 2D shapes while solving *Shape Riddles:* Students have their own sets of shape cards to sort through as they work to identify the mystery shape. The teacher presents one clue at a time until students determine the shape and then repeats the activity.

Students will create Triangular Prisms using Polydrons: The class reviews the attributes of a Triangular Prism. Then they make and test configurations of Polydrons to see which will fold and snap together into triangular prisms and which will not.



Students will sort shapes and then make a graph: Students work together to describe and then sort pictures of various shapes by attributes. After students sort the pictures, the teacher transfers them onto a graphing form and works with input from the class to title the graph and label the columns.

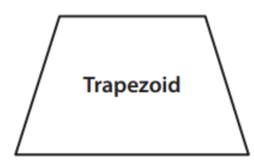
Students study the attributes of 2D shapes while solving more *Shape Riddles:* Students use their own sets of shape cards to sort through as they work to identify the mystery shape. The teacher presents one clue at a time until students determine the shape and then repeats the activity.

Shape Riddles 3 & 4

Guess My Shape 3

1. My shape has more than 3 sides.
2. My shape has fewer than 6 sides.
3. My shape has 4 vertices (corners).
4. One side of my shape is longer than the other 3 sides.

Can you guess my shape?



It's the Trapezoid!

Interdisciplinary / Real World / Global Connections

- 2D and 3D shapes are found everywhere in the real world.
- Dividing objects into equal fractions (halves, thirds, fourths) is a useful skill in our everyday lives.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively
☐ Writing effectively for a variety of purposes
☐ Presenting ideas accurately with the support of engaging media
☒ Thinking critically to solve problems and reach well-reasoned judgments
☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

English Language Learners (ELL):

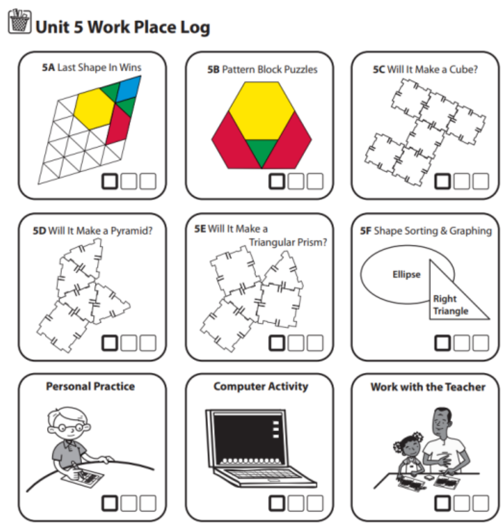
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 5 Shapes Checkpoint

Shapes Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Colors shapes to identify them *Colors shapes according to the instructions; does not color either the ellipse or the circle at all.*	Supports 1.G	**12 pts.** • 1 pt. for each correct answer	
2a Indicates that a circle is not a triangle *No*	1.G.1	**1 pt.**	
2b Explains why the shape is not a triangle *Student work will vary.*	1.G.1	**1 pt.** for any reasonable explanation	
3 Draws a shape with 4 corners and 4 sides all the same length, and identifies it as a square or rhombus	1.G.1	**2 pts** • 1 pt. for a reasonably accurate drawing of a square or rhombus • 1 pt. for identifying the shape	
4a Identifies a cube *Circles the cube in the collection*	Supports 1.G	**1 pt.**	
4b Identifies a cylinder	Supports 1.G	**1 pt.** for drawing a red line under the cylinder	
4c Identifies the construction that can't be built with the available collection of blocks *Circles the third construction in the row.*	1.G.2	**1 pt.**	
4d Identifies a triangular prism as the missing block and draws a picture to show that shape	1.G.2	**1 pt.** for drawing either a triangle or a reasonable facsimile of a triangular prism.	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**20 pts.**	

* **5–20 points:** Working at Tier 1 or Tier 2 Level **4 points or fewer:** May need Tier 3 Support

- Unit 5 Post-Assessment

Unit 5 Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Colors shapes to identify them *Colors shapes according to the instructions; does not color either the ellipse or the circle at all.*	Supports 1.G	**12 pts.** • 1 pt. for each correct answer	
2a Indicates that a circle is not a triangle *No*	1.G.1	**1 pt.**	
2b Explains why the shape is not a triangle *Student work will vary.*	1.G.1	**1 pt.** for any reasonable explanation	
3 Draws a shape with 4 corners and 4 sides all the same length, and identifies it as a square or rhombus	1.G.1	**2 pts.** • 1 pt. for a reasonably accurate drawing of a square or rhombus • 1 pt. for identifying the shape	
4a Identifies a cube *Circles the cube in the collection*	Supports 1.G	**1 pt.**	
4b Identifies a cylinder	Supports 1.G	**1 pt.** for drawing a red line under the cylinder	
4c Identifies the construction that can't be built with the available collection of blocks *Circles the third construction in the row.*	1.G.2	**1 pt.**	
4d Identifies a triangular prism as the missing block and draws a picture to show that shape	1.G.2	**1 pt.** for drawing either a triangle or a reasonable facsimile of a triangular prism.	
		Subtotal page 1	

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 6: Figure the Facts with Penguins
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. **Attend to precision.**
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
1.OA.1 Solve addition and subtraction story problems with sums and minuends to 20 involving situations of adding to, putting together, taking from, taking apart, and comparing with unknowns in all positions
1.OA.2 Solve story problems involving addition of 3 whole numbers whose sum is less than or equal to 20

1.OA.4 Solve subtraction problems by finding an unknown addend 1.OA.6 Add and subtract fluently with sums and minuends to 10 1.OA.6 Use strategies to add and subtract with sums and minuends to 20 1.OA.6 Use the relationship between addition and subtraction to add and subtract within 20 1.OA.7 Demonstrate an understanding that the equal sign indicates equivalence 1.OA.7 Determine whether addition and subtraction equations are true 1.OA.8 Solve for the unknown in an addition or subtraction equation involving 3 whole numbers 1.NBT.3 Compare pairs of 2-digit numbers 1.MD.1 Order 3 objects by length 1.MD.1 Compare the lengths of 2 objects indirectly by comparing the length of each to a third object **Supporting Standards:** 1.NBT Group and count objects by 2s

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Count by 2’s to 20. 2. Add and subtract within 20. 3. Add and subtract fluently within 10 4. Solve for an unknown in an addition equation involving 3 whole numbers (2 addends and a sum). 5. Solve addition story problems with sums to 20 involving situations of adding to and putting together, with unknowns in all positions. 6. Solve subtraction problems by finding an unknown addend.	1. Forward/Backward counting sequence to 100 and counting sequence by 2’s, 5’s and 10’s 2. Part-part-whole reasoning, the commutative property of addition to add, and equivalence. 3. The difference between addition and subtraction, and equivalence. 4. Teen numbers are made up of a group of 10 and some ones and write numbers to 20.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What happens when we join two (or more) quantities?	1. Addition is the action of joining two or more whole numbers to get a new total (sum).
2. What happens when we separate two quantities?	2. Subtraction is the action of taking one quantity away from the other to get the difference.
3. How can we solve addition and subtraction problems in different ways?	3. By comparing a variety of solution strategies, students build a stronger understanding of addition and subtraction and their connection to one another.
4. In what ways are addition and subtraction alike and different?	4. Fact families reveal the relationships between addition and subtraction. Inverse operations connect addition and subtraction facts to each other, but the properties of addition and subtraction help us define the ways they are different.
5. How can we use math to solve problems?	5. Mathematical equations and expressions can be used to model situations and problems from the real world.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: *When using Tech-Enhanced Activities (TEAs), the following standard will be used.* **Standard 1.5.b**: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
Informational Texts: • **Informational Books:**

- Twelve Snails to One Lizard
- Measurement Books

- **Media:**
    - Counting with a Leprechaun

MLC Apps:
- Number Frames App
- Number Rack App
- Fuzz Bugs Number Bond
- Penguin Addition, Subtraction Facts
- Ten Frame Game

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:
Add: to combine; to put together two or more quantities.
Compare: to examine to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Count On: to count in forward order, starting from a given number.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Equal: of the same amount or value.
Equation: a math statement asserting that two quantities have the same value.
Even Number: a number that can be exactly divided by 2; all even numbers end with 0, 2, 4, 6, or 8.
Fact Family: a set of equations that relate addition and subtraction or multiplication and division; said to be a family because each equation has the same numbers.
Foot (ft.): a U.S. customary unit of length equal to 12 inches.
Greater Than: a symbol used to indicate that the number on the left is greater than the number on the right.
Height: how tall something is; the measurement from top to bottom of an object or a shape.
Inch (in.): a U.S. customary unit of length equal to 1/12 of a foot.
Less than: a symbol used to indicate that the number on the left is less than the number on the right.

Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement.
Subtract: to take one quantity away from another or find the difference between two quantities.
Sum or Total: the result of adding two or more numbers.
Triangle: a two-dimensional (flat) shape with 3 sides.

Learning Plan

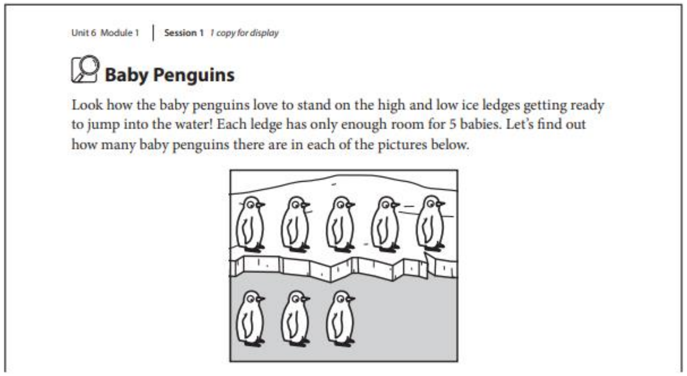
Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

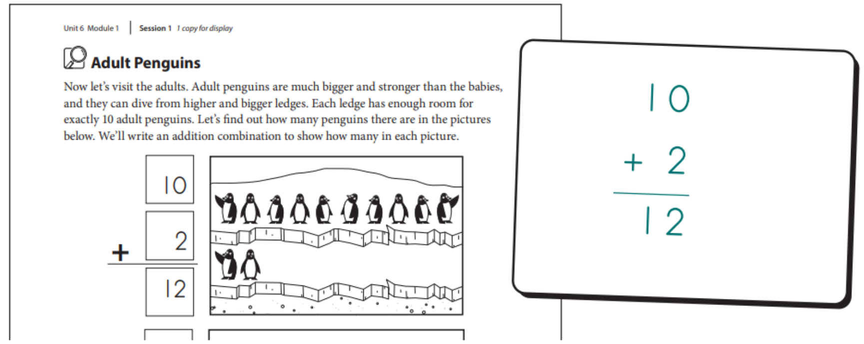
Unit 6 is tightly focused on addition and subtraction to 20. During this unit, first graders continue to develop fluency with addition and subtraction facts to 10 and strategies for working with facts to 20. Students make extensive use of the number rack to model and solve number combinations and story problems of all types. In the process, they learn how to write and solve equations that involve unknowns in all positions and determine whether addition and subtraction equations are true or false. Throughout the unit, the interesting and sometimes amazing habits of penguins offer engaging story problem contexts for young learners.

Week One: The penguins stage a return. Penguins standing on ice ledges, huddling in groups for warmth, laying eggs, and catching fish provide story problem settings and visual models for reviewing addition and subtraction strategies for facts to 20. During these lessons, students review combinations of 10, Add Ten, Add Nine, and Doubles. They also investigate three strategies useful in working with subtraction combinations to 20: taking away, finding the difference, and using familiar addition facts to help solve related subtraction facts.

Students review the ten-frame and double ten-frame, presented in the form of penguins standing on ice ledges:
Tell students those penguins love to dive off ledges, or shelves, of ice into the cold water to swim and catch fish. Sometimes they dive from high ledges. Sometimes they dive from low ledges. Let the students know that today they'll be counting and adding penguins diving from high and low ledges.



Students *I saw 5 on top right away, and then I went 6, 7, 8 real fast. Teacher said 5 on each ledge, so I knew it was going to be 5 on top. Then it was 3 more, and 5 plus 3 is 8.*
I thought about 10, and there were 2 missing, so I knew right away it was 8.



Students *I knew it was going to be 10 on top 'cause of what the page said, and then I saw 2 on the bottom. Ten and 2 is 12.*
It's easy to add when the first number is 10, because it just picks up the other number in its backpack and carries it away.

Students explore combinations of 10 and the *Add Ten Facts* with stories about penguin huddles:
Explain that emperor penguins gather in huddles to keep warm in the freezing wind and cold of the Antarctic winter. Real huddles are much larger than 10 penguins, and the penguins take turns moving to the inside where it's warmest. For today, however, you're going to work with small huddles. Reveal the first part of problem 2. Read the text with the class and ask students what they need to do before they can answer the question.

Teacher *We all agree that there are 8 penguins on the ice floe, and now we need to figure out how many more penguins have to join the group to make a huddle of 10. I'm going to write an equation right beside the picture to show the problem we're trying to solve.*

Unit 6 Module 1 | **Session 2** *1 copy for display*

Penguin Huddles

1 Penguins get together in groups, called huddles, to keep warm. How many penguins do you see in this huddle?

2 How many more penguins need to join each group to make a huddle of 10?

$8 + \boxed{} = 10$

Students explore the Doubles Facts by studying pairs of penguin eggs:

Open today's session by explaining that the penguins are going to help everyone learn more about the addition Doubles facts, like 7 + 7 and 8 + 8, and also counting by 2s today. Display the top portion of the Penguin Egg Doubles Teacher Master, keeping the rest of the sheet covered for now. Read and discuss the text with the students.

Then uncover the rest of the sheet to reveal the penguin eggs chart. Read the text and discuss the chart with the class. Students will work in pairs to complete the chart.

Bridges in Mathematics Grade 1 Teacher Masters

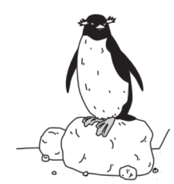
Penguin Egg Doubles

Female penguins, including the rockhopper, lay 2 eggs at a time.

How many eggs would 2 rockhoppers lay?

How many eggs would 3 rockhoppers lay?

We are going to use a special kind of chart today to help keep track of how many eggs different numbers of female penguins would lay. It looks like this.



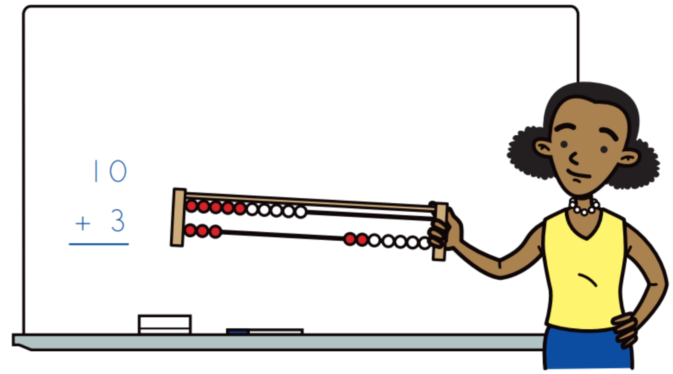
Female Penguins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eggs															
Totals	2	4	6												

Unit 6 Module 1 | **Session 3** *1 copy for display*

T5

Students use their number racks to model and solve story

problems about penguins who love to catch and eat fish:



Open today's session by explaining that you are going to pose some story problems today about penguins who love to eat fish. As students solve the problems, they'll learn more about adding 10s and adding 9s. Read the following problem to the students and write an addition combination to match. Then work with their input to model and solve it on the demonstration number rack:

- *A penguin ate 10 fish. A few minutes later, the penguin ate 3 more fish. How many fish did the penguin eat in all?*

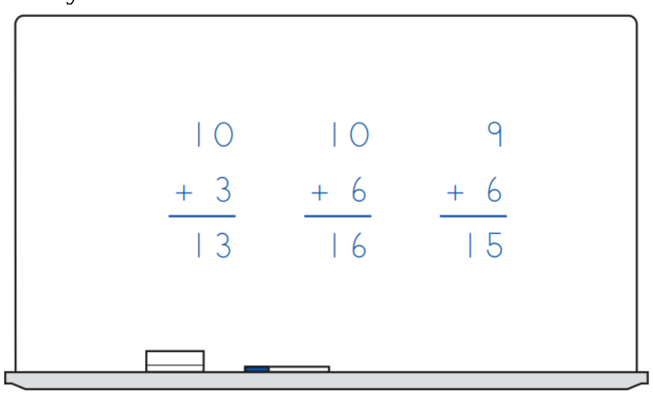
Repeat this process with a second example. Have the students model the problem on their individual number racks. Read the following problem:

- *On Sunday, Penny the Penguin ate 10 fish for breakfast. Then she ate 6 more for lunch. How many fish did she eat in all?*

Repeat this process with a third example that involves adding 9 instead of 10 to a one-digit number:

- *Remember, on Sunday Penny the Penguin ate 16 fish. She had 10 fish for breakfast and 6 for lunch. Well on Monday, Penny ate only 9 fish for breakfast. Then she ate 6 more fish for lunch. How many fish did she eat in all?*

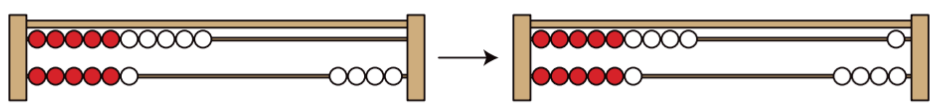
Ask students to reflect on the similarities and differences between this combination and the one they just solved, 10 + 6. As you talk with them, guide them to see that if 10 + 6 is 16, 9 + 6 will be 1 less, 15. Then record the two combinations, with their solutions, side by side on the board.



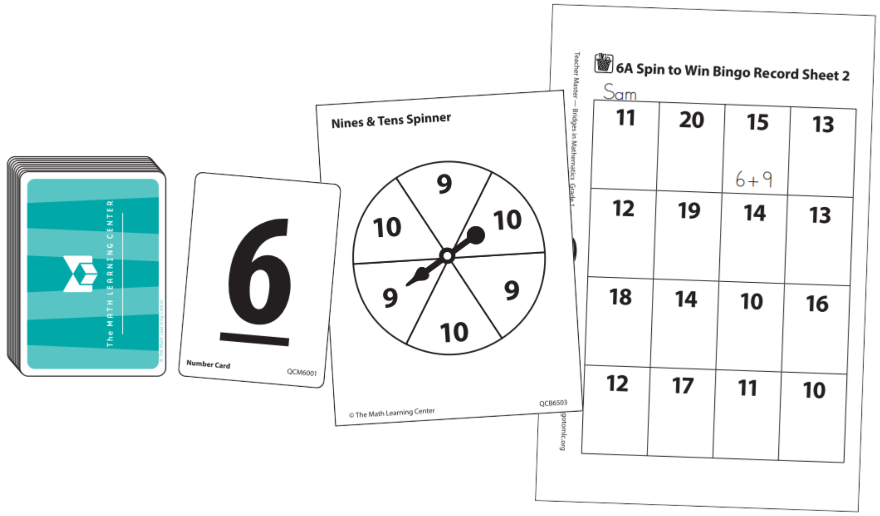
Teacher *What needs to change on our number rack so it shows how many fish Penny ate today?*

Student *You need to take away on bead on the top row because Penny only ate 9 fish today for breakfast.*

Teacher *OK, why don't you come up and move one of the beads so everyone can see your idea?*

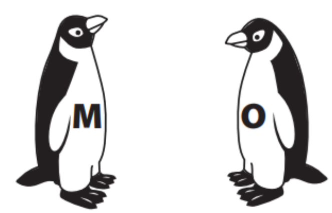


Students practice adding 10s and adding 9s by playing *Spin to Win Bingo:*
Partners take turns drawing a Number Card, then spinning a Nines & Tens Spinner to see how much to add. They find the correct answer on their bingo record sheet and write an expression in the square to show the numbers they added. The first player to get four in a row horizontally, vertically, or diagonally is the winner.



Students model and solve penguin subtraction story problems on their number racks:
Each of the first three story problems elicits a different type of strategy. The first is a take-away strategy, easily modeled on the number rack. The second involves finding the difference between two quantities by counting from the smaller of the two. The third, and most challenging for many first graders, involves solving a subtraction problem by using the related addition fact.

Reveal the first problem, read it with the students, model and discuss strategies.

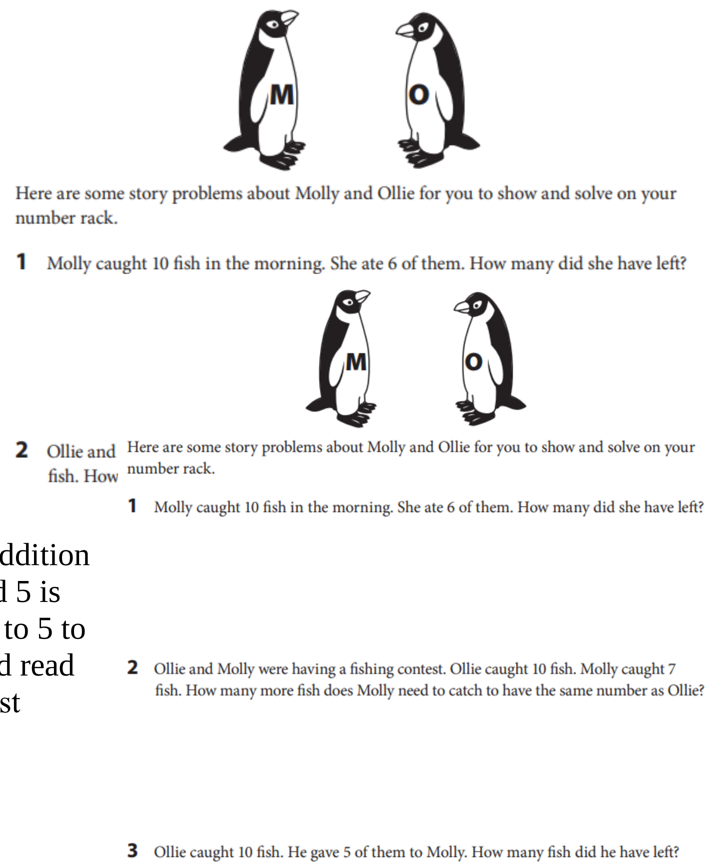


Here are some story problems about Molly and Ollie for you to show and solve on your number rack.

1 Molly caught 10 fish in the morning. She ate 6 of them. How many did she have left?

On your demonstration number rack, model a Take Away strategy to solve this problem. Ask the students to replicate your moves on their own racks. Begin by sliding 10 beads to the left. It is most straightforward to exhaust the top row of beads before moving to the second row. Tell students that we now need to take away 6 beads from the 10. Slide 6 beads back to the right side of the number rack. Record an equation below the first problem (10 – 6 = 4) and read it as, "10 take away, or minus, 6 is 4." Then explain that the strategy you just used to solve the problem is called the *Take Away* strategy.

Draw students' attention back to the Molly & Ollie Teacher Master. Reveal the second problem and read it with them. On your demonstration number rack, model a *Count Up* strategy to solve this problem. Ask the students to replicate your moves on their own racks. Start by sliding 7 beads to the left, all on the top row. Ask: "How many more beads do we need to add to 7 in order to make 10?" Slide 3 beads to the left and confirm with students that Molly needs 3 more fish to have the same number as Ollie (10). Record an equation below the second problem (10 – 7 = 3), and read it as, "The difference between 10 and 7 is 3." Then explain that the strategy you just used to solve the problem is called the *Count Up* strategy.



M O

Here are some story problems about Molly and Ollie for you to show and solve on your number rack.

1 Molly caught 10 fish in the morning. She ate 6 of them. How many did she have left?

2 Ollie and fish. How

M O

Here are some story problems about Molly and Ollie for you to show and solve on your number rack.

1 Molly caught 10 fish in the morning. She ate 6 of them. How many did she have left?

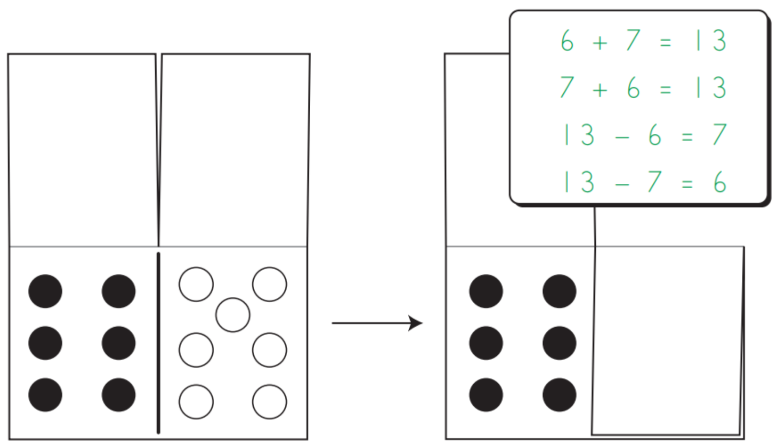
2 Ollie and Molly were having a fishing contest. Ollie caught 10 fish. Molly caught 7 fish. How many more fish does Molly need to catch to have the same number as Ollie?

3 Ollie caught 10 fish. He gave 5 of them to Molly. How many fish did he have left?

Draw students' attention back to the Molly & Ollie Teacher Master. Reveal the third problem and read it with them. Ask students to solve this problem in their heads and show thumbs up when they have the answer. • When most thumbs are up, have the class report the answer aloud. Ask several students to share how they got the answer. Some will likely say that they just already knew it. Explain that sometimes students just know the answer to subtraction problems, and sometimes they use an addition fact they already know to help. Ask whether anyone used the fact that 5 and 5 is 10 to help solve 10 – 5 or thought about how many they would have to add to 5 to get 10 in all. Record an equation below the second problem (10 – 5 = 5) and read it to the students as "10 minus 5 is 5." Then explain that the strategy you just described is called *Working from an Addition Fact You Already Know*.

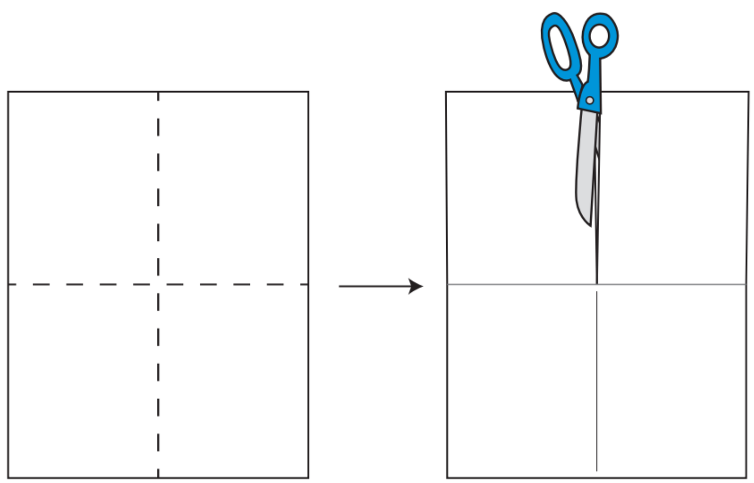
Week Two: The activities this week continue to focus on addition and subtraction story problems and fact strategies to 20. Students make double-flap dot cards and picture cards, writing sets of fact family equations and story problems to match. They model and solve addition combinations to 20 on their number racks, identifying such strategies as working with easier combinations like 10 + 4 and 7 + 7 to solve more challenging combinations such as 9 + 4 and 7 + 8. A game at the end of the module, *Pick Two to Make Twenty*, sets work with addition combinations in an appealing and challenging context. The week concludes with a short checkpoint assessment.

Students will generate fact families to 10 by making Double-Flap Dot Cards:
Hold up the back of the first Double-Flap Dot Card (6 dots and 7 dots) so students can see the numeral you have written: 13. Turn the card over, but do not lift the flaps yet, and explain that the black dots under one flap and the white dots under the other flap add up to 13. Lift the first flap so they can see the 6 dots. Have them pair-share ideas about how many dots are under the other flap and invite a few students to share their thinking. Now lift the second flap so students can see both sets of dots. Work with their input to record the four equations in this fact family.



Tell students they are each going to make their own double-flap dot card and write the fact family that goes with it. Then model the process for the class:

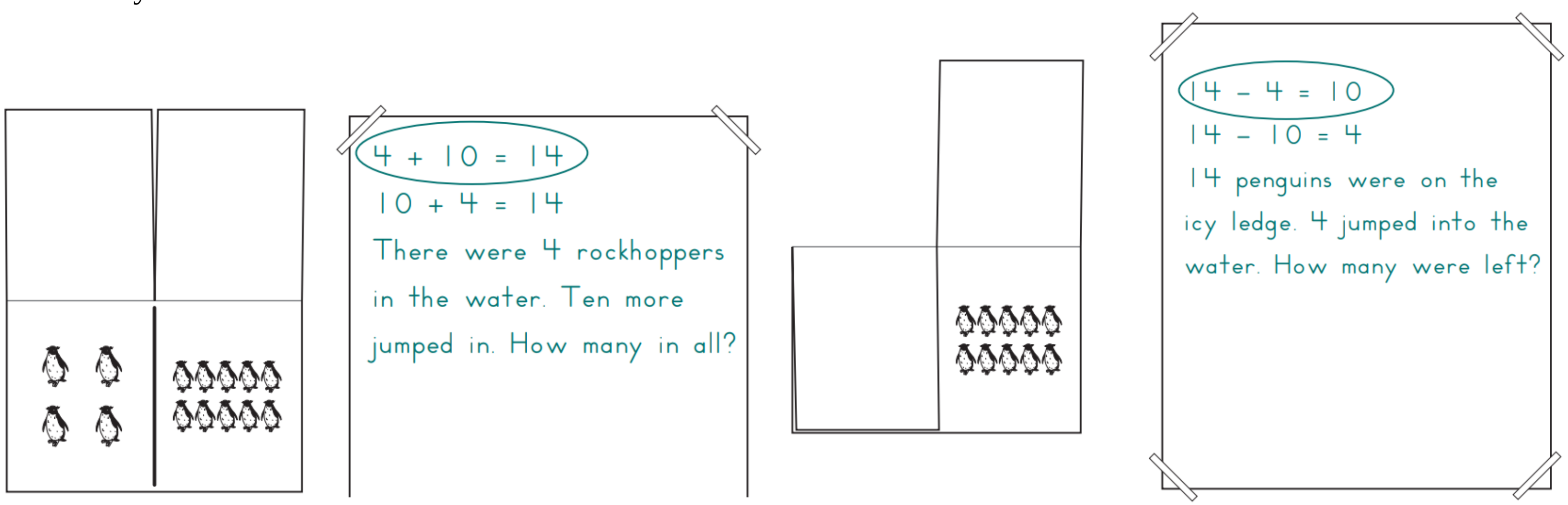
- Fold a full sheet of copy paper in fourths. Open the piece of paper out flat, and cut the top half as shown to create two



flaps.

- Choose a number from 11 to 20 for your total. Write it on the back of the folded card.
- Draw and color two sets of dots that combine to make your chosen total. Use one color for the first set and a second color for the second set.
- Write the fact family for your double-flap dot card on a half-sheet of copy paper

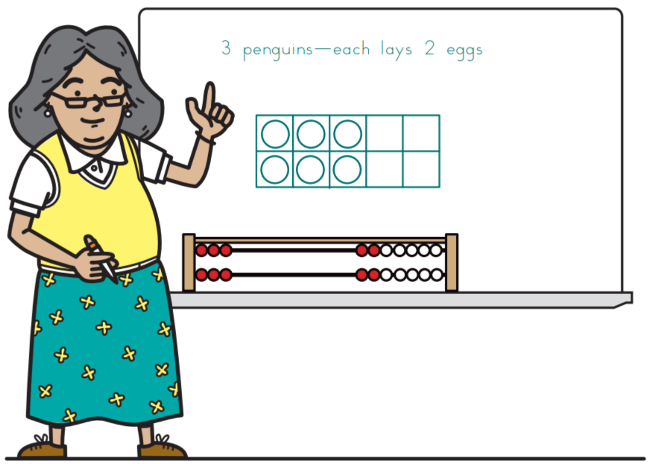
Students will study the relationship between fact families and story problem by making Double-Flap Picture Cards:
Open the session by explaining that you have a different kind of double-flap card to share with them today. Hold up the back of the first Double-Flap Penguin Picture Card so students can see you've written the numeral 14. Turn the card over, but don't lift the flaps yet, and explain that there are some rockhopper penguins under one flap and some more under the other, and the number of penguins in all is 14. Ask students to pair-share some ideas about the number of rockhoppers under each flap. Then lift the first flap on the card, so they can see the 4 penguins. Have them pair-share ideas about how many penguins are under the other flap, and invite a few students to share their thoughts. Now lift the second flap so students can see both sets of penguins. Work with their input to record two addition sentences that reflect the quantities on both sides of the card and the total. Explain that you are going to write a story to match one of the equations. Now work the students to record the two subtraction sentences that reflect the card and write a story to match.

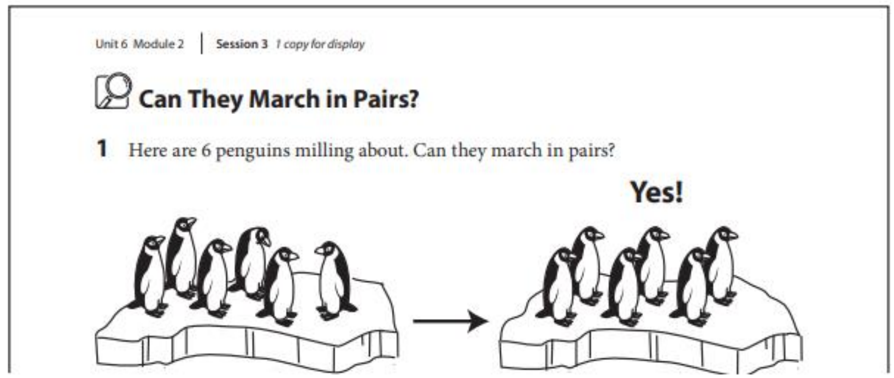


Students work together to determine whether different quantities of penguins can march in pairs or not:
Open this session by explaining that the penguins are going to help the class learn more about adding numbers to 20. Next, draw

their attention to the demonstration number rack, and ask them if it is possible to model the same situation—3 penguins, each penguin lays 2 eggs—on the number rack.

Now let students know that you're going to do some more work with pairs and doubles today, using the theme of penguins learning to march together. Display the text and the picture at the top left of the Can They March in Pairs? Ask them to consider the problem. Can this group of 6 penguins march in pairs? Are there enough penguins for each one to have a partner?

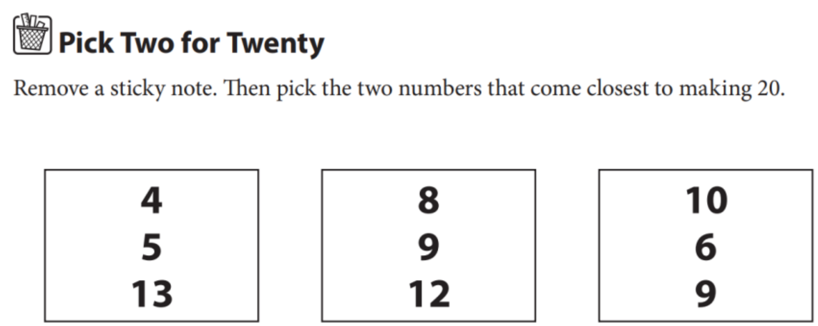



Unit 6 Module 2 | Session 3 1 copy for display

Can They March in Pairs?

1 Here are 6 penguins milling about. Can they march in pairs?

Students will practice adding up to a sum of 20 by playing *Pick Two to Make Twenty:*
Display the Pick Two for Twenty Teacher Master. Read the text at the top of the sheet with the class and note with students that it is covered with sticky notes. Explain that there are three numbers under each sticky note. When it is their turn, the students will get to remove one of the sticky notes from the sheet, look at the three numbers, and choose the two that will add to make a total that is closest to 20 without going over.


Pick Two for Twenty

Remove a sticky note. Then pick the two numbers that come closest to making 20.

4 5 13	8 9 12	10 6 9

Administer the Combinations & Stories Checkpoint:

- Read and explain the instructions for each problem.
- When students understand what to do, let them go to work.
- Circulate as they work to assist as needed. Let students know that it's fine to raise their hand and ask you to read one or more of the problems to them again.

Combinations & Stories Checkpoint page 1 of 2

1 Which two numbers add up to 20?

- Circle the two numbers in each set that add up to 20.
- Write an equation with those two numbers.

ex

18 **9** **2**

_______ + _______ = _______

a

12 **10** **8**

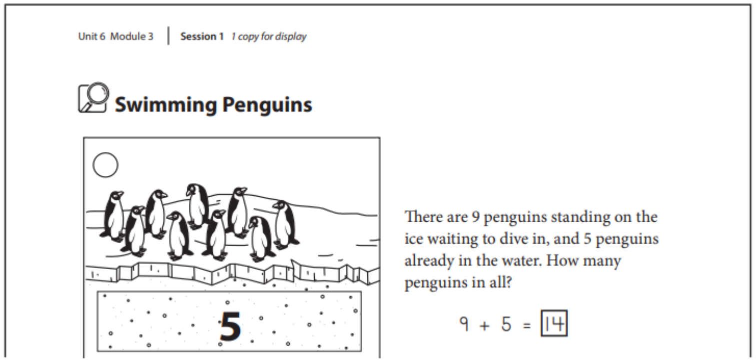
_______ + _______ = _______

Week Three: The activities this week center on story problems. Using their number racks and the fact strategies they've been working on, students solve three types of addition and subtraction story problems: result unknown (10 + 4 = ? and 15 – 6 = ?), change unknown (10 + ? = 14 and 15 – ? = 9), and start unknown (? + 4 = 14 and ? – 6 = 9). Students also work with part-whole and comparison situations. Translating story problems to equations is emphasized throughout, and the teacher introduces a new Work Place game in which students work together to draw number cards and arrange them to form true equations. The week concludes with a Unit Assessment.

Students will solve addition story problems about penguins with sums up to 20:
Open today's session by letting students know that the penguins are back with some new story problems that will help everyone learn more about addition. Display the first problem on the Swimming Penguins Teacher Master, keeping the others covered for now:

- *There are 9 penguins standing on the ice waiting to dive in, and 5 penguins already in the water. How many penguins in all?*

Ask students to solve the problem on their number racks. When they believe they have the answer, have them share and compare with the people sitting next to them, and then hold up their racks for everyone to see.

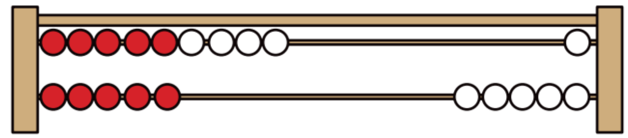

Unit 6 Module 3 | Session 1 *1 copy for display*

Swimming Penguins

There are 9 penguins standing on the ice waiting to dive in, and 5 penguins already in the water. How many penguins in all?

9 + 5 = 14

Student A *I put 9 on the top and 5 on the bottom. Then I started with the 9 and just kept counting, 10, 11, 12, 13, 14. I got 14.*



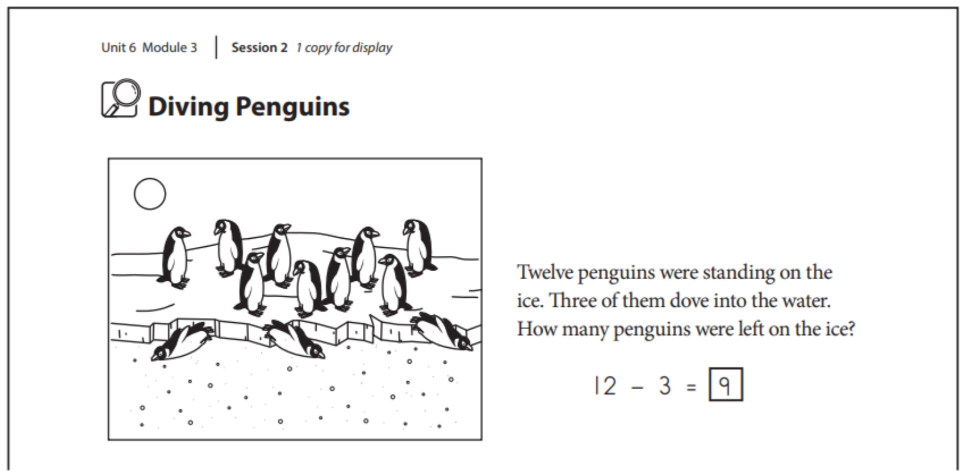
Student B *I put 9 on top and then 5 on the bottom. When I looked, I could see 10 red beads because of 5 and 5, and then 4 more white beads, so I knew it was 14.*

Repeat for the remaining story problems.

Students will solve subtraction story problems about penguins:

Open today's session by letting students know that the penguins have some subtraction story problems for them today. Display the first problem on the Diving Penguins Teacher Master, keeping the others covered for now. Give students a few moments to examine the problem quietly. Then read the text aloud with the class:

- *Twelve penguins were standing on the ice. Three of them dove into the water. How many penguins were left on the ice?*


Unit 6 Module 3 | Session 2 *1 copy for display*

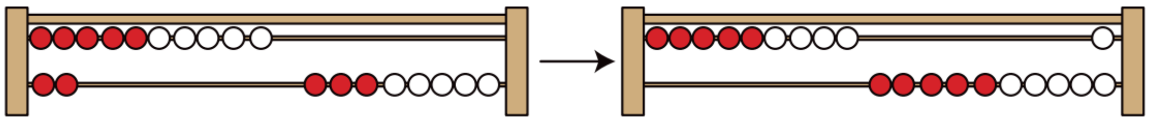
Diving Penguins

Twelve penguins were standing on the ice. Three of them dove into the water. How many penguins were left on the ice?

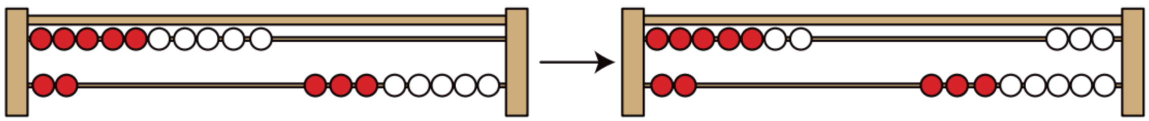
12 − 3 = 9

Ask students to solve the problem on their number racks. When they believe they have the answer, have them share and compare with the people sitting next to them, and then hold up their racks for everyone to see.

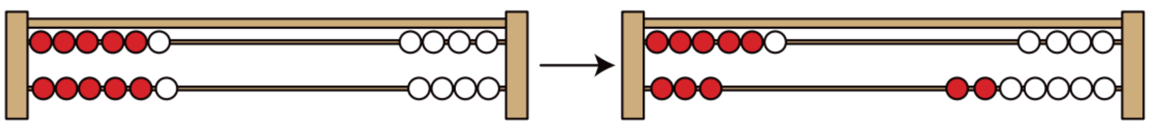
Student A *I put 10 on the top and 2 on the bottom to make 12. Then I took away 3 for the penguins that went in the water. I took away 2 from the bottom and 1 from the top. There were 9 left.*



Student B *I moved over 12. Then I took 3 away from the top. See, there are 9 left—7 on top and 2 more on the bottom.*



Student C *I made 12 with 6 and 6, like this. Then I took 3 away. There were 9 left.*



Repeat for the remaining subtraction story problems.

Students will solve two types of story problems: *whole is unknown,* and *part is unknown*:
Open today's session by explaining to students that sometimes scientists known as wildlife biologists travel to the places where animals, such as penguins, live to study them. Today's first activity is about two such scientists, Shelly and Mark, who have traveled to the Antarctic to study emperor penguins. Today they are collecting feathers.

Pose the following problem to the class:

- *Mark and Shelly were gathering penguin feathers on the beach. The feathers were either all black, or all white. Both Mark and Shelly each collected 10 feathers. Shelly found 6 black feathers and 4 white feathers. On your whiteboard, show one example of how many black and white feathers Mark might have found.*

Solicit responses from students, and list them on the chart in Mark's column.

Then pose the following problem:

- *The next day, both Mark and Shelly found 15 feathers. Some were black, and some were white. Can you come up with two combinations of feathers for Mark (e.g., 9 black, 6 white), and two different combinations of feathers for Shelly?*

Solicit responses from students, and list them on the chart in both Mark and Shelly's columns.
Finally, pose the following problem:

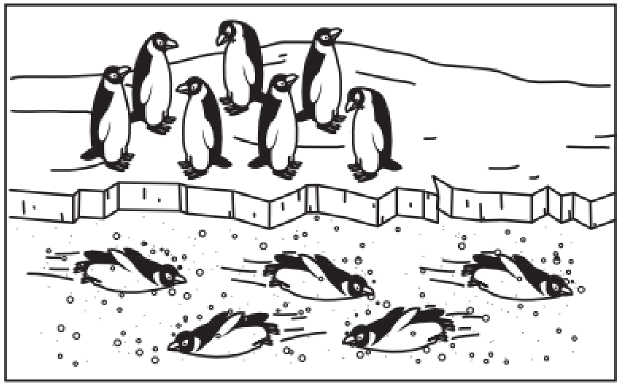
- *Shelly found 5 white feathers and some black feathers. Mark found 6 black feathers and some white feathers. They both found 10 feathers in all. How many white feathers did Mark find? How many black feathers did Shelly find?*

Shelly's Feathers	Total Feathers	Mark's Feathers
Black | White		Black | White
6 + 4	10	7 + 3 5 + 5 8 + 2 1 + 9 10 + 0 4 + 6
10 + 5 11 + 4	15	7 + 8 9 + 6

$\square$ + 5	10	6 + $\square$

Students solve a collection of story problems that involve comparing quantities of penguins standing on the ice and swimming in the water:
Display the first picture and the text directly below it on the Comparing Penguins Teacher Master. Give students a few moments to examine the picture and the text quietly. Then read the text below the picture to the class, and ask students to pair share observations. Ask students to model this situation on their number racks, using the beads in the top row to represent the penguins standing on the ice and the beads in the bottom row to represent the penguins swimming in the water.

Comparing Penguins



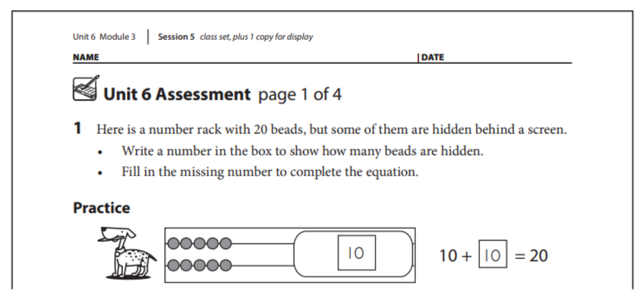
7 penguins are standing on the ice.
5 penguins are swimming in the water.

Solve these problems:

- How many more penguins are on the ice than in the water?
- How many more penguins would need to be in the water to match the number on the ice?
- How many penguins in all?

Repeat the process with the remaining problems.

Administer Unit 6 Assessment:
Complete practice problems and review together. Read directions aloud and allow students to work independently.



Unit 6 Module 3 | Session 5 *class set, plus 1 copy for display*

NAME | DATE

Unit 6 Assessment page 1 of 4

1 Here is a number rack with 20 beads, but some of them are hidden behind a screen.

- Write a number in the box to show how many beads are hidden.
- Fill in the missing number to complete the equation.

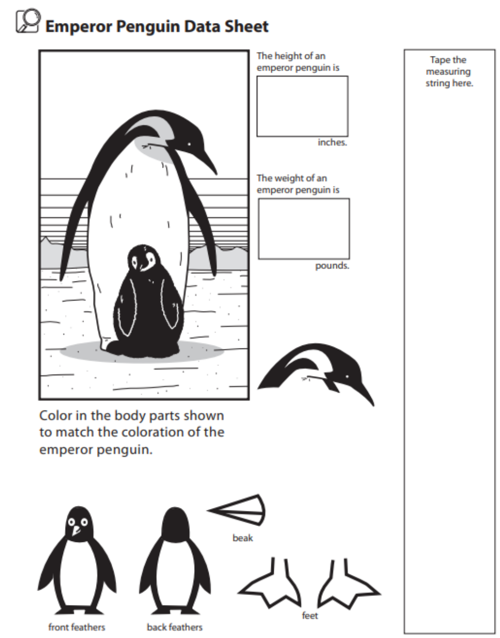
Practice

10

10 + $\boxed{10}$ = 20

Week Four: This week's lessons revisit the penguin measurement activities from Unit 4, Week 4. In the first three sessions, students have more opportunities to measure and compare penguins' height as well as order two-digit numbers and use inequality signs as they study Emperor and little blue penguins. The last two sessions are devoted to counting by 2s as students each create a pair of identical paper penguins, help to assemble a class chart, discuss the patterns they see, and use what they've learned to complete their own counting grid.

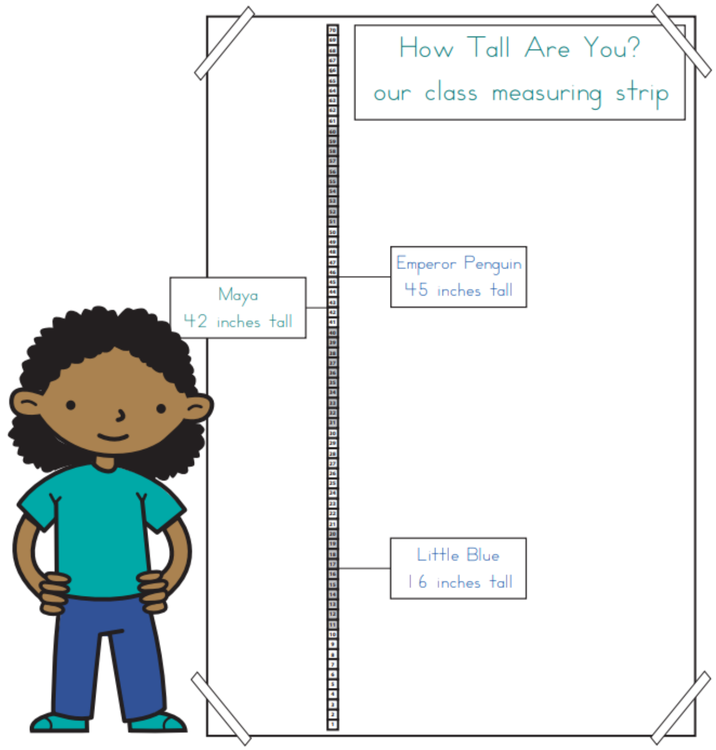
Students measure and compare the height of an Emperor Penguin:
Open today's session by letting students know that they are going to study two more penguins over the next couple of days, starting with emperor penguins today. Have students gather around the class measuring strip where paperclips and labels indicate the heights of the rockhopper (18") and king (36") penguins the class studied at the end of Unit 4. Ask students where the paperclip and label for the emperor penguin should be (at 45") and add them to the strip.

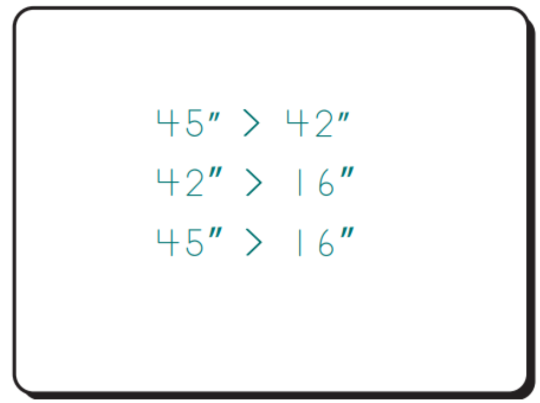


Hand out lengths of string, along with students' measuring strips from Unit 4, Week 4. As students work in pairs to cut 45" lengths, circulate and help, checking their measurements before they cut. Since some students might be shorter than 45" they will need to borrow a measuring strip from a taller classmate. Have students hold their lengths of string up next to themselves to see how they compare, and then tape their strings onto their Emperor Penguin Data Sheet.

Students measure and compare the height of a Little Blue Penguin:
Explain that today the students will learn about the Little Blue penguin and they will compare their own height with that of the little blue and the emperor penguins. Have students gather around the class measuring strip and explain that you have removed the paperclips and labels for the rockhopper and king penguins to make it easier to compare the emperor and the little blue. Ask students where to place the paperclip and label for the little blue penguin (at 16") and add them to the strip. Now discuss this question with students: How do you think your height compares with these two penguins?

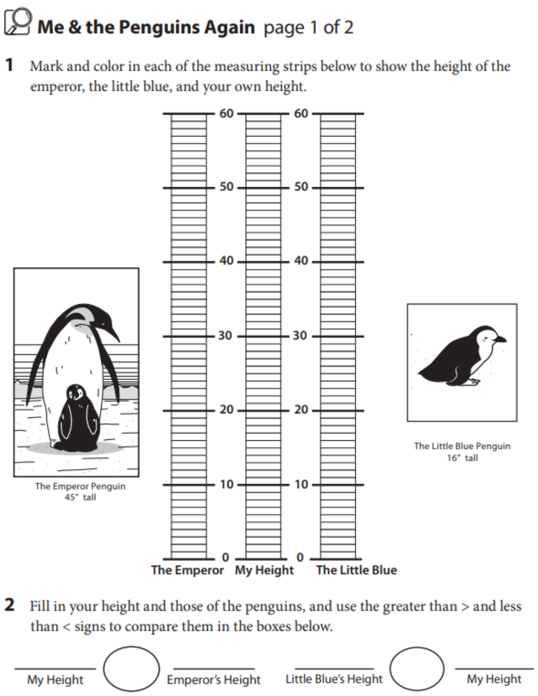
Using a whiteboard, record inequality statements as students do the same, comparing the three heights.





Students will solve problems about the differences in their heights compared to the penguins:
Review the heights of the emperor penguin, the little blue penguin, and the student from the previous session, noting the paperclips that indicate their heights on the class measuring strip. Review which of the three heights is taller, which is shorter, and which is the shortest. Explain that today students will do some problem solving and then compare themselves with the penguins.

Students will complete the *Me & the Penguins Again* page with the heights of each penguin and themselves. Students will use inequality symbols to compare the different heights.

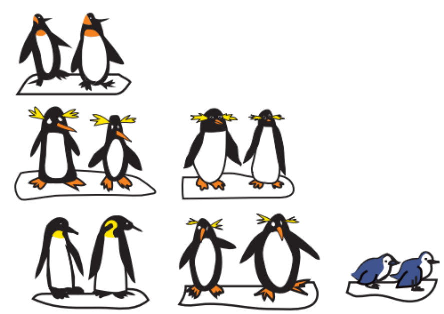

Me & the Penguins Again page 1 of 2

1 Mark and color in each of the measuring strips below to show the height of the emperor, the little blue, and your own height.

2 Fill in your height and those of the penguins, and use the greater than > and less than < signs to compare them in the boxes below.

Students practice counting by 2s when drawing pairs of penguins:
Explain to students that their task is to make two small cutout paper penguins that look alike. They need to be colored and shaped accurately enough so that everyone can tell what species they are. Briefly demonstrate how you might begin by cutting a piece of black paper in the penguin shape of your choice, and then cutting and pasting the white paper for the tummy feathers on top of the black.

When most students are done, have them return to the discussion circle with their penguin pairs. Call on students one at a time to temporarily arrange their penguin pairs in the center of the circle. Have them place one pair in the first row, two pairs in the second row and so on. Students can briefly talk about their penguins as they add them to the arrangement. Have students share their observations about the arrangement as it is developing, and then at the end. Jot down their comments so you can type or print them and add them to the



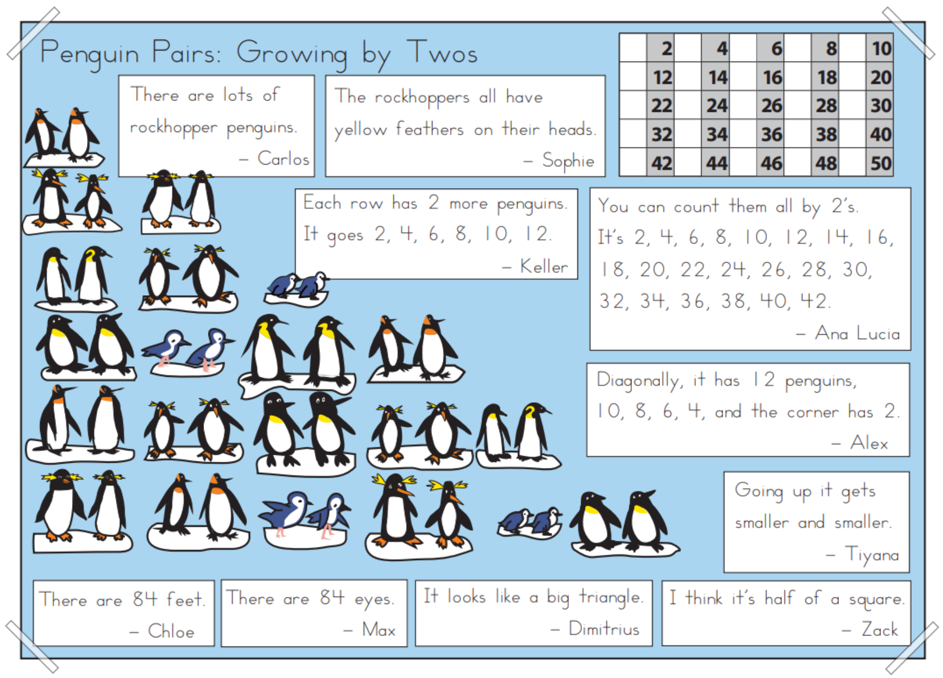
Students *There are all different kinds of penguins.*
Each row has 2 more penguins. It goes 2, 4, 6, 8, 10, 12 if you count the penguins in each row.
Every row gets longer.
You can count them all by 2s. It's 2, 4, 6, 8, 10, 12…

Teacher *Hang on! Let's all count the penguins by 2s. Why don't you take the yardstick and point to each of the pairs as we all count by 2s.*

penguin chart later.

Students practice counting by 2s by examining the finished Penguin Pairs chart from the previous session:
Introduce the session by explaining that today you will review their comments on the chart and look for patterns on the Counting by Twos grid:

- Read each of the observation bubbles on the chart with the students.
- Direct students' attention to the Counting by Twos grid you've glued to the chart.
- Why are some of the numbers missing?
- What do the numbers that are shown on the grid have to do with the penguin pairs on our chart?
- What patterns do you notice in each row? Each column?



Interdisciplinary / Real World / Global Connections

- Applying operations such as addition and subtraction to story problems models the way we use math in the real world every day.
- Students notice things that come in pairs: car wheels, insect legs, their own eyes, hands, and feet. This makes facts about doubles one of the first strategies they learn.
- Measuring length and height is used in the home and in a variety of careers.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively
☐ Writing effectively for a variety of purposes
☐ Presenting ideas accurately with the support of engaging media
☒ Thinking critically to solve problems and reach well-reasoned judgments
☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

English Language Learners (ELL):

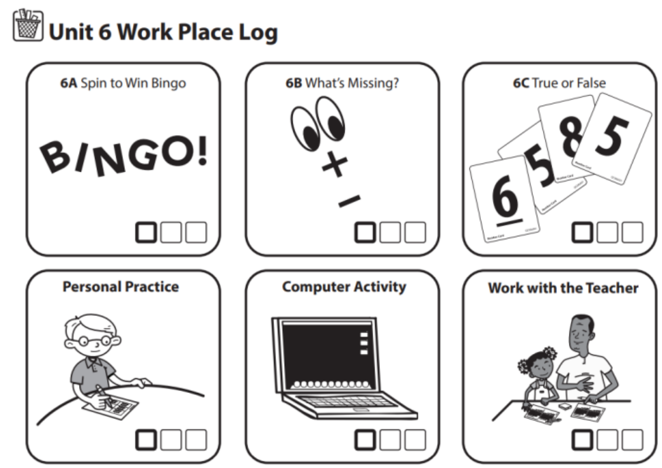
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 6 Combinations & Stories Checkpoint

Combinations & Stories Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name																	
1 Chooses the 2 numbers out of a set of three that add to 20. Writes an equation with those numbers. *a. 12 and 8, 12 + 8 = 20* *b. 7 and 13, 7 + 13 = 20* *c. 5 and 15, 5 + 15 = 20* *d. 14 and 6, 14 + 6 = 20*	1.OA.6	**8 pts.** (2 pts. per problem) • 1 pt. for selecting the correct pair of numbers • 1 pt. for writing an equation with those numbers																		
2 Solves subtraction facts with minuends to 20. *10, 7, 2, 6*	1.OA.6	**4 pts.** • 1 pt. for each correct answer																		
3a Solves an addition story problem that involves joining two sets. Shows work. *There are 14 penguins in all.*	1.OA.1	**3 pts.** • See scoring scale below.																		
3b Solves an addition story problem that involves finding the missing addend. *It takes 3 penguins to make 10.*	1.OA.1	**3 pts.** • See scoring scale below.																		
TOTAL SCORE/LEVEL OF PROFICIENCY*		**18 pts.**																		

Scoring Scale for Solving Story Problems (3 points possible for each problem):

- 1 point for using the information given in the problem
- 1 point for using a viable strategy that could lead to the answer; strategies may include drawings, equations, numeric representations, etc.
- 1 point for showing the correct answer

* **5–18 points:** Working at Tier 1 or Tier 2 Level
4 points or fewer: May need Tier 3 Support

- Unit 6 Post-Assessment

Unit 6 Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name									
1a–d Writes a number to show how many beads are hidden on the number rack. Completes the matching equation. *5, 2, 8, 6*	1.OA.6 1.OA.8	**8 pts.** 2 pts. for each item, 1 for writing the correct number on the number rack, and 1 for completing the equation correctly										
2 Solves 14 addition combinations. Fact types include Make 10s, Add Tens, Doubles, and Doubles Plus or Minus 1. *10, 14, 17, 12, 10, 19, 14, 20, 10, 9, 10, 7, 10, 8*	1.OA.6	**14 pts.** 1 pt. for each correct answer recorded during the 3-minute timing										
3a–f Indicates whether each addition or subtraction equation is true or false *true, false, true, false, false, true*	1.OA.6 1.OA.7 1.OA.8	**6 pts.** 1 pt. for each correct answer										
4 Solves 14 subtraction combinations. These subtraction combinations are related to addition Doubles, Make 10s, and Doubles Plus or Minus 1. *5, 4, 9, 0, 8, 6, 2, 1, 9, 1, 3, 1, 10, 4*	1.OA.4 1.OA.6	**14 pts.** 1 pt. for each correct answer recorded during the 3-minute timing										
5a Solves a subtraction story problem that involves finding the missing subtrahend *4 penguins jumped into the water.*	1.OA.1 1.OA.6 1.MP.1	**3 pts.** See scoring scale below.										
5b Solves a story problem that involves finding the missing addend or the difference between 13 and 4. *There are 9 penguins hiding behind the hill.*	1.OA.1 1.OA.6 1.MP.1	**3 pts.** See scoring scale below.										
5c Solves a subtraction story problem that involves finding the difference between two quantities *There are 5 more penguins standing on the ice than swimming in the water.*	1.OA.1 1.OA.6 1.MP.1	**3 pts.** See scoring scale below.										
TOTAL SCORE/LEVEL OF PROFICIENCY*		**51 pts.**										

Scoring Scale for Solving Story Problems (3 points possible for each problem):

- 1 point for using the information given in the problem
- 1 point for using a viable strategy that could lead to the answer; strategies may include drawings, equations, numeric representations, etc.
- 1 point for showing the correct answer

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 7: One Hundred & Beyond
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** 1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. Construct viable arguments and critique reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. **7. Look for and make use of structure.** 8. Look for and express regularity in repeated reasoning. **Priority/Focus Standards:** 1.OA.2 Solve story problems involving addition of 3 whole numbers whose sum is less than or equal to 20 1.NBT.1 Count to 120, starting with any number less than 120, including 0 or 1 1.NBT.1 Read and write numerals to 120

1.NBT.1 Represent a number of objects with a written numeral up to 120
1.NBT.2 Demonstrate an understanding that the digits in a 2-digit number represent amounts of tens and ones
1.NBT.3 Compare pairs of 2-digit numbers; use >, =, and < symbols to record comparisons of two 2-digit numbers
1.NBT.4 Add a 1-digit number and a 2-digit number
1.NBT.4 Add a multiple of 10 (up to 80) and another 2-digit number
1.NBT.4 Use concrete models or drawings and strategies based on place value, properties of operations, or the relationship between addition and subtraction to add with sums to 100
1.NBT.4 Relate strategies for adding with sums to 100 to written methods; use written numbers and symbols to represent strategies for adding with sums to 100
1.NBT.4 Explain the reasoning behind a strategy used to add with sums to 100
1.NBT.4 Add with sums to 100 using strategies that involve adding tens to tens and ones to ones, as well as composing a ten (regrouping)
1.NBT.5 Mentally find the number that is 10 more or 10 less than a given 2-digit number, without counting, and explain the reasoning used
1.NBT.6 Use concrete models or drawings to subtract a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10
1.NBT.6 Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to subtract a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10
1.NBT.6 Relate strategies for subtracting a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10 to written methods
1.NBT.6 Use written numbers and symbols to represent strategies for subtracting a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10
1.NBT.6 Explain the reasoning behind a strategy used to subtract a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10

Supporting Standards:
1.NBT Count by 5s and 10s to 100
1.MD Determine the value of a collection of coins totaling less than $1.00

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*

1. Identify 10 as a composition of ten ones. 2. Identify the smaller numbers that make up a larger number (part-part-whole). 3. Count to 120, starting at any number less than 120. 4. Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <. 5. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10. 6. Use concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. 7. Break apart a larger quantity into at least two groups of smaller quantities.	1. Sets of ten must be perceived as a single entity when interpreting numbers using place value (e.g., 1 ten is one group, it is 10 ones). 2. Numbers can be composed and decomposed. 3. The same quantity can be created in many ways. 4. When counting, the last number counted is the total number of items; it is a cumulative count. 5. Counting tells how many objects in a quantity. 6. The two digits of a two-digit number represent amounts of tens and ones. 7. Benchmark numbers such as 5 and 10 can be used to compare sets.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can you solve a problem by finding and using a number pattern? 2. How can you show two-digit numbers as groups of tens and ones? 3. How can you use skip counting to find the total number of objects? 4. How can you change a number by adding or subtracting 1 to the ones place or tens place? 5. How can you explain how adding groups of 10 is like adding numbers less than 10?	1. Numbers have a sequence and represent quantity. 2. The two digits of a two-digit number represent amounts of tens and ones. 3. Benchmark numbers such as 5 and 10 can be used to compare sets. 4. The tens place is equal to 10 ones. 5. Groups of 10 can be treated as a single entity.

Resources

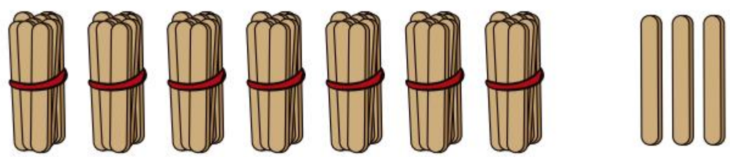
Student Technology Integration and Correspondence to ISTE Standards when Applicable: *When using Tech-Enhanced Activities (TEAs), the following standard will be used.* **Standard 1.5.b**: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

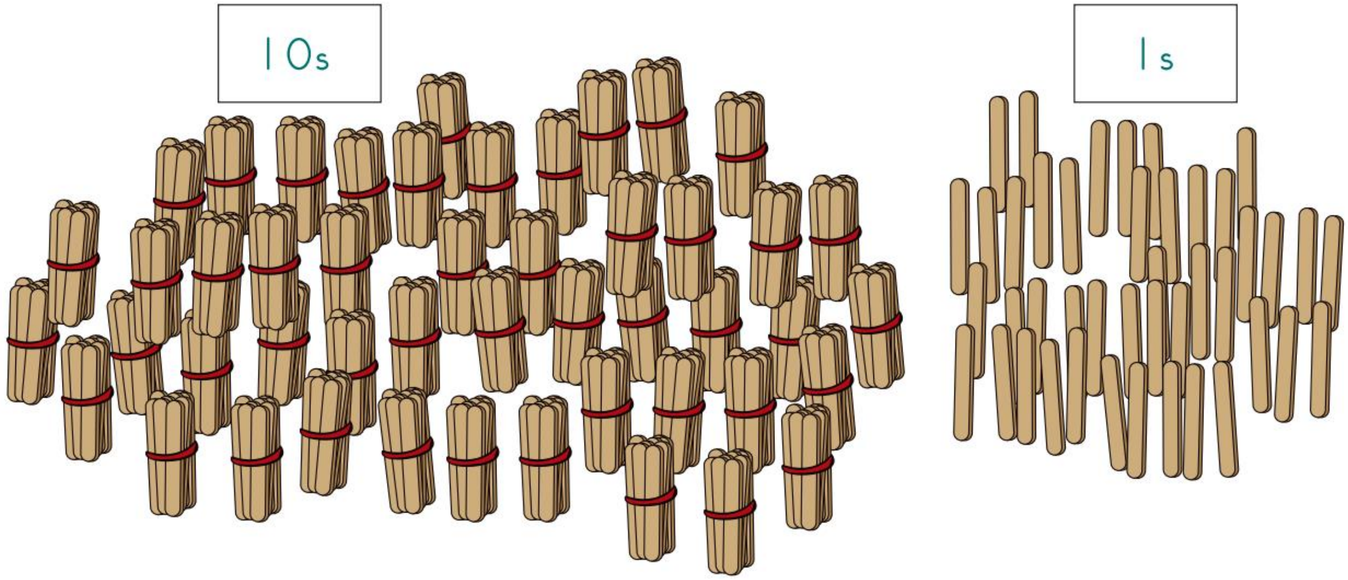
Informational Texts:
• **Informational Books:**
    ○ Great Estimations
    ○ Money Books
    ○ The Penny Pot
 	
• **Media:**
    ○ Ready or Not, Here I Come
    ○ Hey, Honey Bunny! I Know My Money, Money
    ○ Show Me the Money
 	
MLC Apps:
• Flip Counter
• Grouping & Grazing
• Number Line App
• Okta's Rescue
• Adding 10 Depth Charger
• Addition With Manipulatives
• Number Flash
• Compare Money Amounts
• Count Pennies, Nickels and Dimes
• Count Pennies, Nickels, Dimes and Quarters
• Equivalent Coins
• How Much is the Coin Worth?

Vocabulary/Terminology

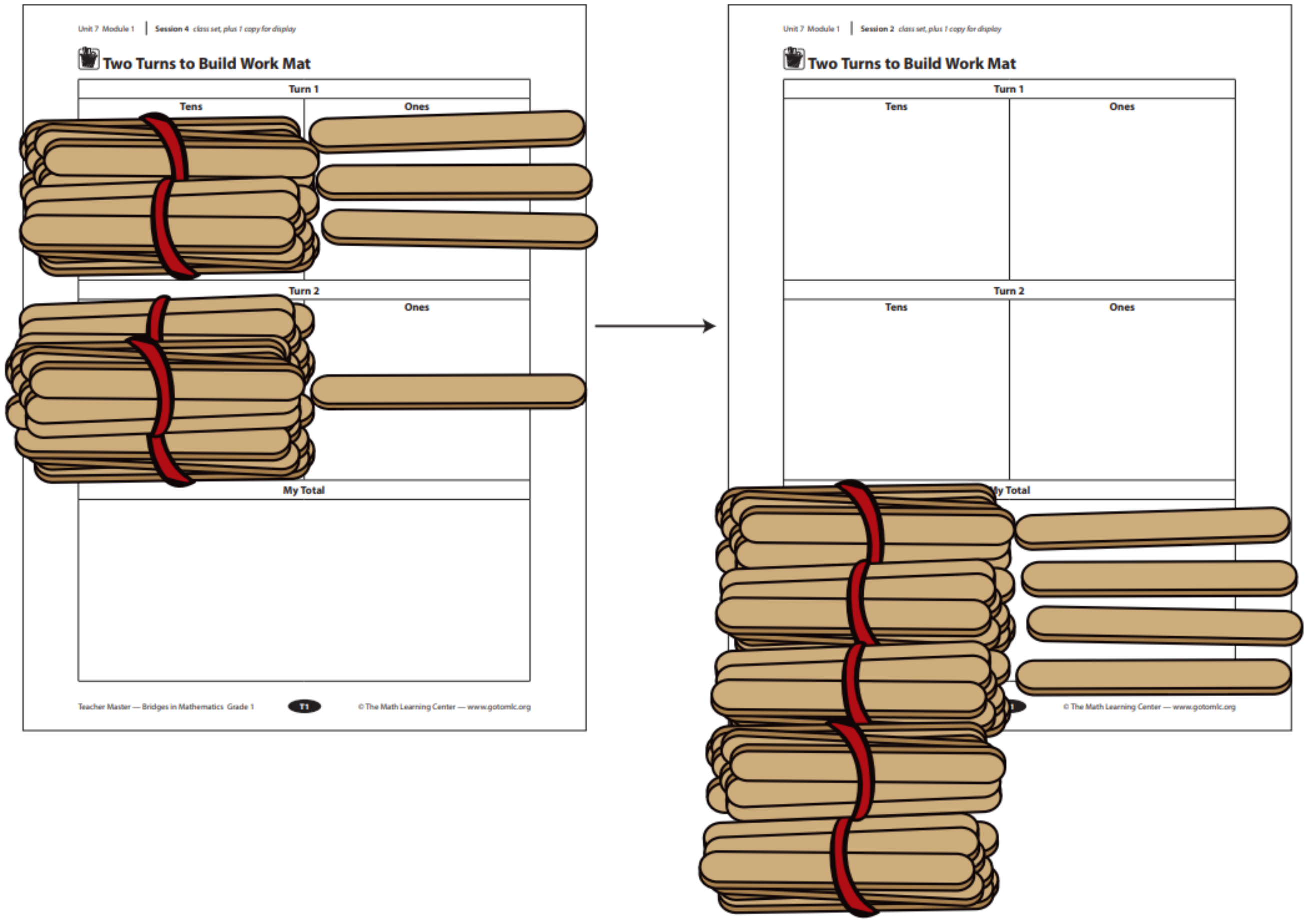
Vocabulary/Terminology with Definitions:

Add: to combine; to put together two or more quantities.
After: following in time, place, or sequence.
Before: ahead of time, place, or sequence.
Compare: to examine to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Count Back: to count in backward order, starting from a given number.
Count On: to count in forward order, starting from a given number.
Count: to name units in a group one by one in order to determine the total number; counting tells how many objects are in a set.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Digit: any one of the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9.
Dime: a U.S. coin worth 10 cents or 1/10 of a dollar; 10 dimes are equal in value to 1 dollar.
Equation: a math statement asserting that two quantities have the same value.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Fourth: one part when a number, shape, or set is divided into exactly four equal parts; also called a quarter.
Greater Than: a symbol used to indicate that the number on the left is greater than the number on the right.
Hundreds: the numbers 100 to 999; also refers to the hundreds place.
Length: how long something is.
Less Than: a symbol used to indicate that the number on the left is less than the number on the right.
Nickel: a U.S. coin worth 5 cents or 1/20 of a dollar; 20 nickels are equal in value to 1 dollar.
Ones: the numbers 0 to 9; also refers to the ones place.
Penny: a U.S. coin worth 1 cent or 1/100 of a dollar; 100 pennies are equal in value to 1 dollar.
Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles.
Subtract: to take one quantity away from another or find the difference between two quantities.
Sum or Total: the result of adding two or more numbers.
Tens: the numbers 10 to 99; also refers to the tens place.

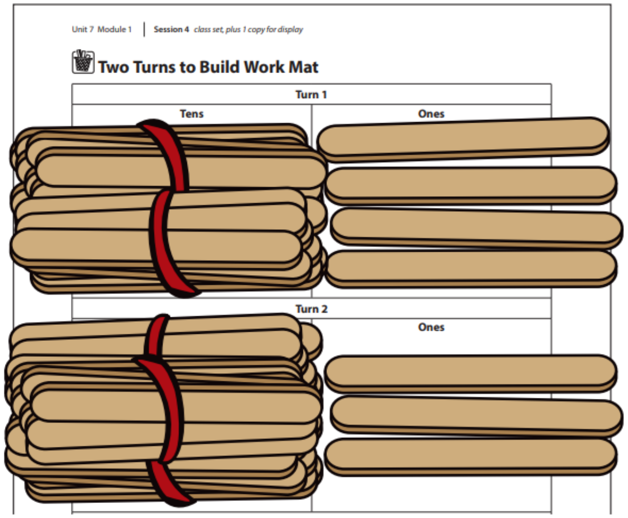
Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Learning Tasks Per Week (Including Instructional Strategies) *The focus of Unit 7 is place value. During this unit, first graders continue to develop deep understandings of numbers to 120 as they estimate, count, compare, add, and subtract two-digit quantities using familiar models: sticks & bundles; dimes, nickels, and pennies; and the number line.*
Week One: This week the students work with numbers up to 100 and beyond. They group and count craft sticks by tens and ones, groups tens into hundreds, and use models, sketches, and numbers to add and subtract within 100. **Students will group craft sticks into bundles of 10 and then count by 10s to 100 and more:** Hold up a bag of 500 craft sticks for all to see and tell students that today's problem is to find out how many sticks are in the bag. Explain that first they will estimate the number of sticks and then work together to count them. This will give them lots of counting practice and help them understand numbers over 100. Pour some of the sticks into each of the containers (one container for every four or so students) until there are no more left in the plastic bag. Tell them they will work in groups to count all the sticks in one of the containers, bundle them into groups of 10, and put a rubber band or pipe cleaner around each group.  When everyone has returned to the circle and all of the sticks are set out, work with input from the class to reorganize the sticks so they can be counted most easily.

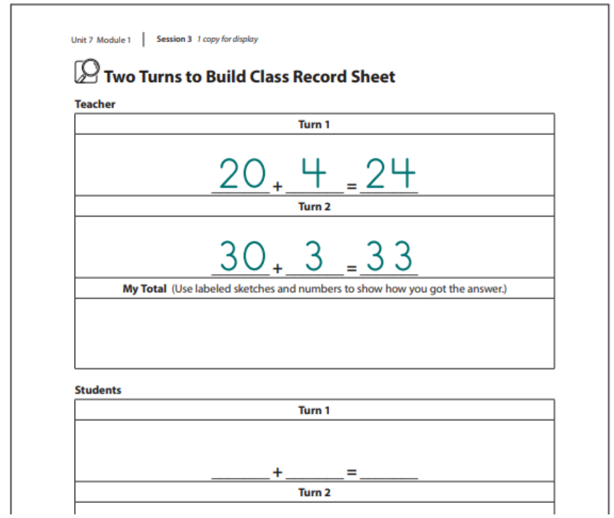


Students will practice adding 2-digit numbers by playing the game *Two Turns to Build:*
Today, the teacher plays a new game against the class. Each team gets two turns to spin a Tens Spinner, and roll a 0–5 die, and collect the designated numbers of craft sticks. The teams each add their two sets of sticks and compare their totals. Students then play in pairs.

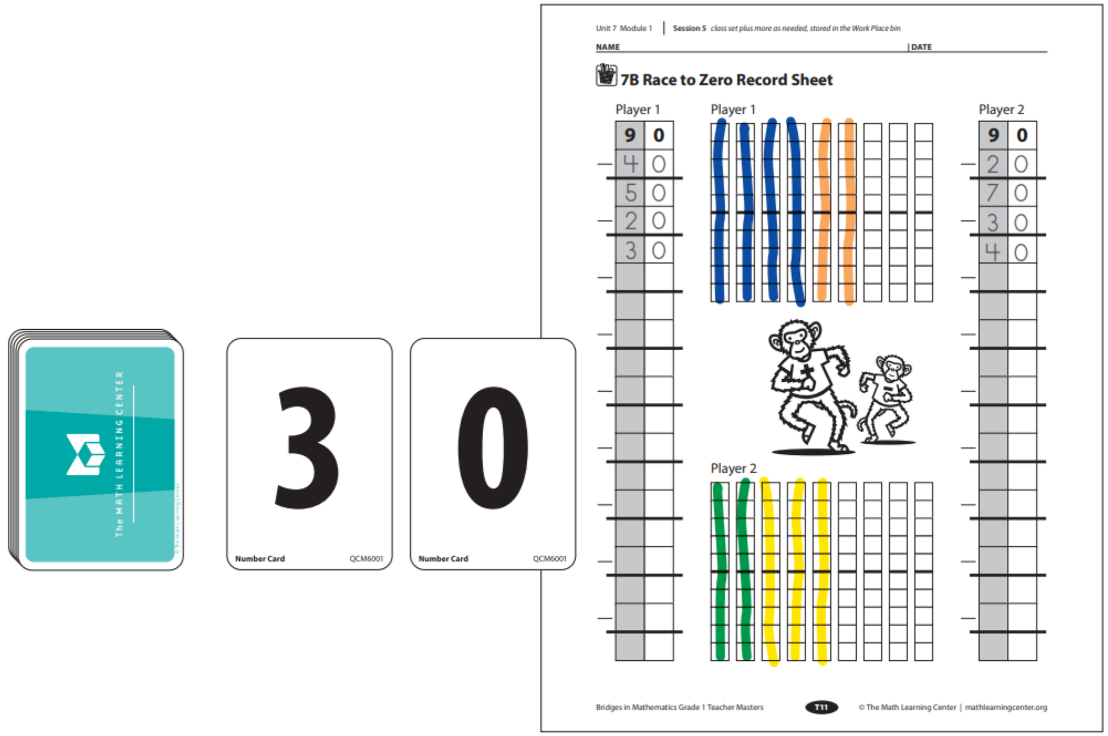


The students again play *Two Turns to Build*, this time recording the 2-digit addition as equations:
Explain that today you're going to play Two Turns to Build again with the class, but this time you're going to use a record sheet to show your thinking and keep score. Display a copy of the Two Turns to Build Work Mat Teacher Master. Explain that, just like last session, you will take turns with the class to spin, roll, and collect two quantities of bundles and sticks to add. The difference is that you'll record the results for both teams on the Two Turns to Build Class Record Sheet today.





Students will subtract multiples of 10 while playing the game, *Race to Zero*:
Today, the teacher introduces a new game, playing against the class to see who can start with 90 and be the first to reach 0 as they subtract multiples of 10 from the starting amount. Number Cards determine how much the teams get to subtract each turn. Students keep track of the action with Unifix cubes or craft sticks as the teacher colors in ten-strips on a record sheet to keep score.



Week Two: This week and the next focus on numbers to 120 on a number line. Students enter the fairytale world of Hansel and Gretel, who create and mark paths by dropping pebbles every 10 steps. When these intervals prove to be too far apart, they use pinecones to mark each halfway point. Finally, they drop breadcrumbs to mark each step. Hungry birds and squirrels have a way of making the breadcrumbs disappear sometimes, leaving interesting gaps here and there. The path like number lines that emerge during this module give students many opportunities to count forward and backward by 1s, 5s, and 10s from a variety of starting points, read and write numbers to 120, and add and subtract 1-digit numbers to and from 2-digit numbers.

Students will practice counting by 1s and 10s by recreating the trail made by *Hansel and Gretel*:
Begin by reminding students of the story of Hansel and Gretel. Either read the story as written, or summarize it, highlighting how the children marked the walking path through the forest with breadcrumbs, and later with pebbles, so they could find their way back to their father's house. Explain that the students are going to pretend to take a walk through the forest like Hansel and Gretel, but

they will be laying down Unifix cubes instead of breadcrumbs or pebbles.
Review the trail-making and marking procedure with the class, modeling it with another student helper if necessary:

- The first partner slowly takes 10 paces, pausing between each step.
- For each pace, the second student places a Unifix cube on the ground, right next to where her partner's foot landed.
- After 10 paces, the students switch roles.
- When they have each taken 10 steps, the pair will leave their Unifix cubes on the ground and return to where they started behind the line.

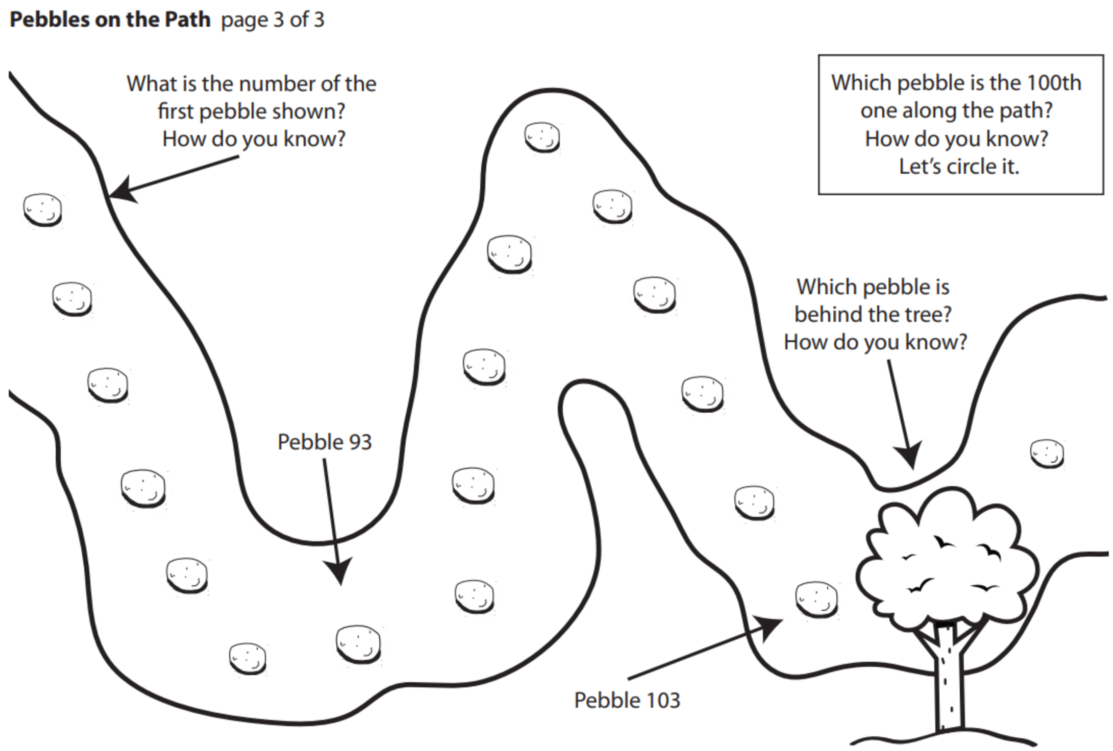
When all the student pairs have returned to the starting line, discuss their trails with the class. Here are some prompts and questions you might use to spark students' thinking:

- Which pair of students appears to have the longest strides? (Which pair went the farthest?)
- Which pair of students appears to have the shortest strides? (Which pair went the shortest distance?)
- How many paces in all were taken by both partners? In other words, how many Unifix cubes are on the ground for each pair?
- Choose the trail of cubes belonging to one pair. Walk down the trail pointing to each cube as you and the students count them.
- Starting at 20, count backward to 1 as you walk back to the beginning of the trail, again pointing to each cube.
- Ask the first student in each pair to go and stand next to the 8th cube in their trail. Ask the second student to stand next to the 18th cube.
- Repeat, this time asking the first student to stand next to the 15th cube, and the second student to stand at the third cube.

The students will practice counting by 10s by adding pebbles along the path for *Hansel and Gretel*:
Let students know that they're going to help Hansel and Gretel mark the paths around their father's house in the woods. Then read the text below to the class to set the context for today's work:

- *During their big adventure in the woods, Hansel and Gretel discovered what a good idea it was to leave markers on the trail so that they could get back home without getting lost. A few days after they returned to their father's house and all was well, they decided that it would be a good idea to mark all the trails near their home so that no matter which road or trail they were on, they could easily follow a path through the forest back to their home. Hansel and Gretel began their work. Hansel would walk 10 steps and stop. Gretel would place a pebble on the path each time Hansel paused. Within a few minutes, they were making great progress.*

Show the students various illustrations of the path and work together to identify all the pebbles.

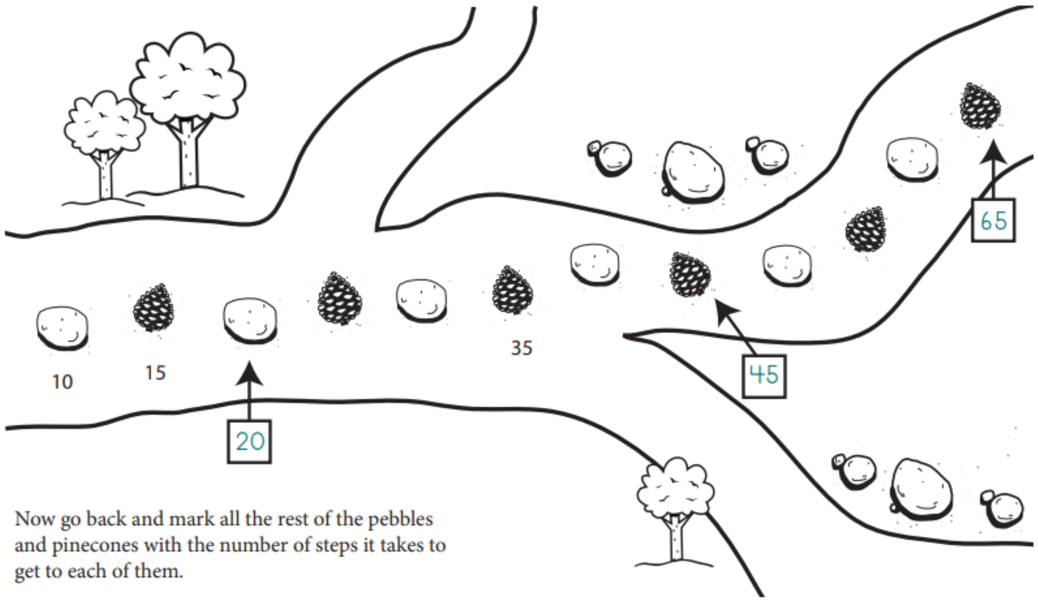


Students will practice counting by 5s by adding pinecones along the path for *Hansel and Gretel*:
Let students know that they are going to do some more path-marking activities today with Hansel and Gretel. Tell the students that Hansel and Gretel have discovered that they have a problem. Depending on where the fork in the path is the next pebble might be too far away to see. Ask students what they should do to solve their problem?

After students have had a chance to share some ideas, explain that Hansel and Gretel decided to solve their problem by placing a pinecone exactly halfway between every 2 pebbles. Display the Pinecones on the Path Teacher Master and give students a few moments to examine it quietly. Then read the text above the illustration and work with them to figure out the number that belongs in each of the empty boxes along the trail.

Pinecones on the Path

Hansel and Gretel decided to take care of their problem by marking the 5th step between every two pebbles with a pinecone. Here is a section of the path marked with pebbles and pinecones. Use the clues to figure out the number of steps it takes to get to each of the pinecones or pebbles marked with an empty box.



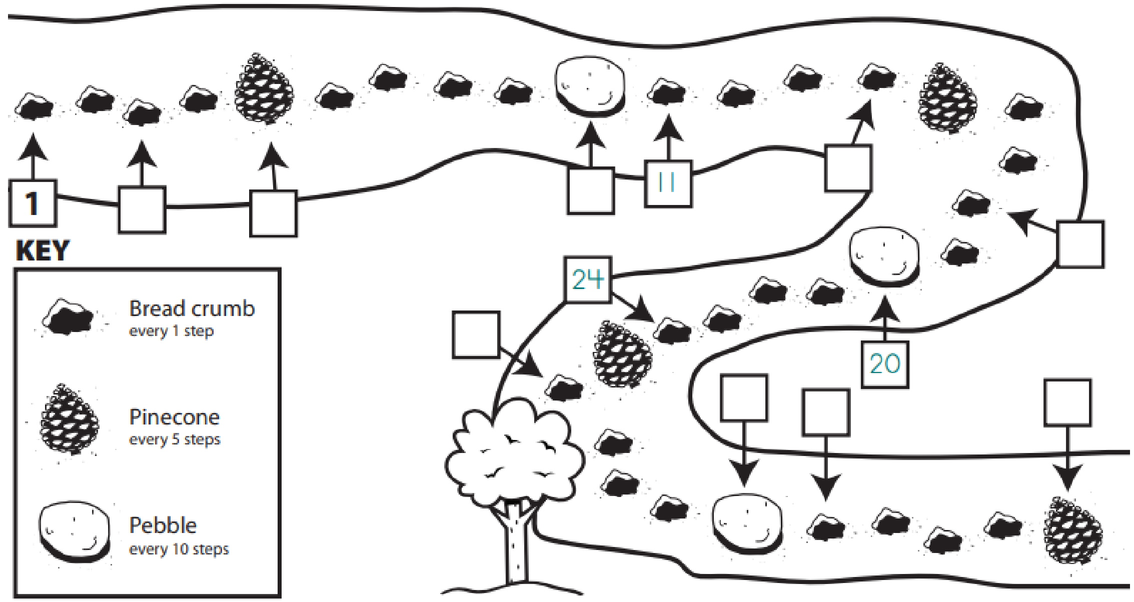
Now go back and mark all the rest of the pebbles and pinecones with the number of steps it takes to get to each of them.

Students count by 1s, 5s and 10s using the Path made by Hansel and Gretel:
Open the session by returning to the original story of Hansel and Gretel. Remind students that Hansel and Gretel used breadcrumbs at one point to mark their trail. Then let students know that today you're going to show them a path that has been marked with pebbles, pinecones, and breadcrumbs, even though some of the breadcrumbs might be missing here and there. Display the Breadcrumbs, Pinecones & Pebbles Teacher Master. Ask students to examine the path and share observations, first in pairs and then as a whole group. After students have had some time to share their observations and reflect on some of your questions, work with the class to figure out the number that belongs in each of the empty boxes along the trail.

Bread Crumbs, Pinecones & Pebbles

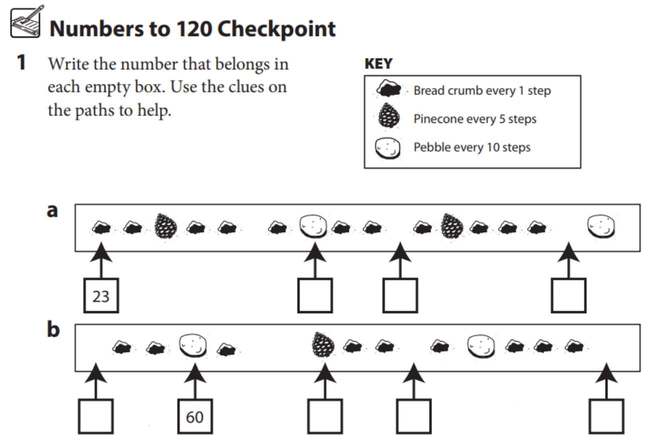
Here is the very first part of the path marked with bread crumbs, pinecones, and pebbles. It begins at step 1. Use the clues in the key to help figure out the number of steps it takes to get to each of the objects marked with an empty box.

Challenge: See if you can solve these problems without counting forward or backward by 1s. Think about counting by 5s or 10s, or adding and subtracting instead.



Administer the Numbers to 120 Checkpoint:

- Read and explain the instructions for each problem.
- When students understand what to do, let them go to work.
- Circulate as they work to assist as needed. Let students know that it's fine to raise their hand and ask you to read one or more of the problems to them again.



Week Three: This week, Hansel and Gretel are having so much fun marking the paths around their house in the woods that they decide to add a few amenities. Each of these objects has a different length; the fence sections are 10 units, the benches 5, the trash cans 2, and the flowerpots 1. This gives students all kinds of interesting opportunities to design paths of different lengths and to compute the lengths of path sections presented to them. The Hansel and Gretel theme culminates in a partner game the students make themselves involving a path 120 steps long. They spin to make jumps of 1, 2, 5, or 10, and later 20 or 30, to race from one end of the path to the other. The game can be played forward or backward and allows students to practice adding and subtracting 2-digit numbers on a number line. The Unit 7 Assessment is conducted during the last session.

Students find combinations of 10 using 1s. 5s and 10s on Hansel and Gretel's path:
Let students know that they're going to help Hansel and Gretel make the paths around their house in the woods even better. Then read the text below to the class to set the context for today's work:

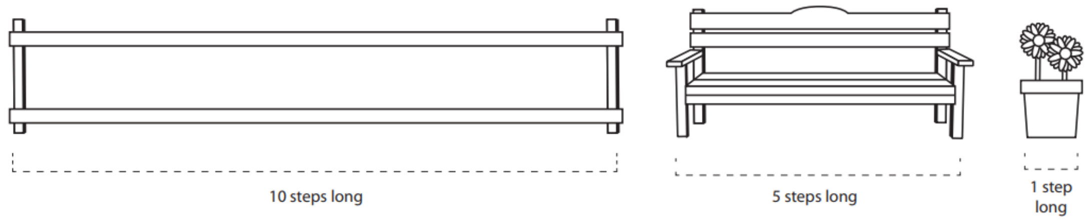
- *Over the last few days, we've been helping Hansel and Gretel mark the walking paths near their little house in the woods. Well, now the trails are so well marked that many people who live in the village nearby are starting to use them too. So the two children decided to clean up the trails a bit. They decided it would be nice to put in some fences and some benches and plant some pretty flowers. They decided that each fence section should be 10 steps long, each bench should be 5 steps long, and each flowerpot should be only 1 step long.*

Display the top section of the Pleasant Paths Teacher Master. Working where students can see what you're doing, use Unifix cubes in
three different colors to build a fence section, a bench, and a flowerpot. Keeping your work visible, create and display several

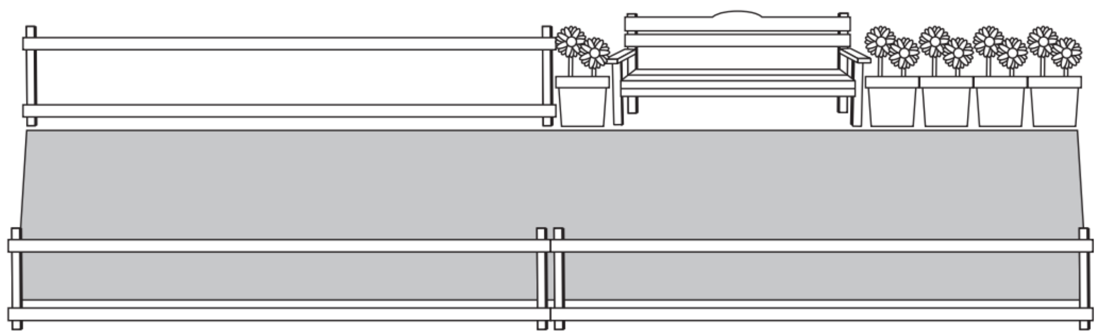
different scenarios with the Unifix cubes, and ask students to discuss each.

Pleasant Paths

Hansel and Gretel decided to make the walking paths around their house in the woods even more pleasant by adding fences, benches, and flowers in pots.



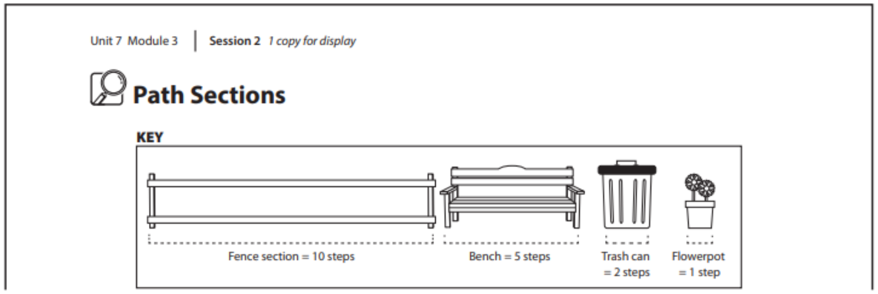
Here's how these things will look when they're placed along the path.

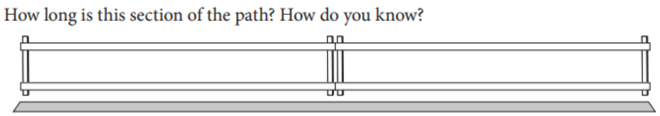


Students find combinations of 20 using 1s. 5s and 10s on Hansel and Gretel's path:
Open today's session by letting students know that Hansel and Gretel's plan to add fences, benches, and flowers to the forest paths made everyone in the village very happy. Then read the text below to the class to introduce a new feature the two children decided to add to the paths:

- *Now that the paths were well marked with fences and had pretty flowers along the way and nice benches to sit on, more people from the village started to take walks in the forest. On the weekends, whole families brought their picnic baskets to the woods, and the forest rang out with the sounds of children laughing and playing. Pretty soon, Hansel and Gretel started finding garbage along the trail—apple cores, orange and banana peels, old napkins—and they realized that they had* *forgotten to provide trash cans. They took care of this right away, and now the paths had fences, benches, trash cans, and pots filled with flowers.*

Display the key at the top of the Path Sections Teacher Master. Now explain that you are going to show students part of the path and ask them to figure out how many steps long it is.



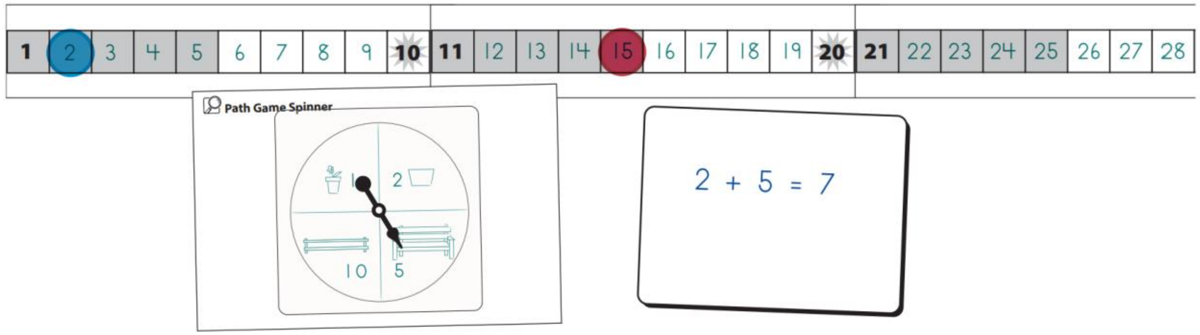


Repeat for each of the other three path sections on the teacher master.

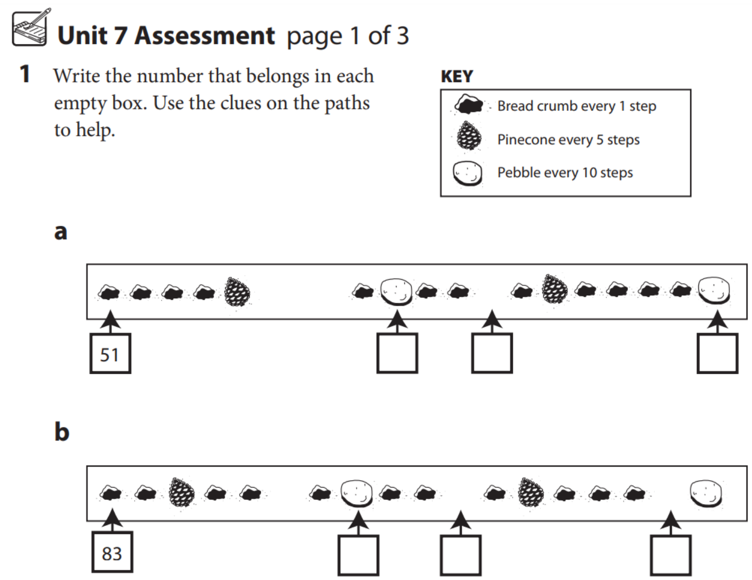
Students will count and add by 1s, 5s and 10s to 120 when playing *The Path Game*:

Show students how to play *The Path Game* by modeling it with a partner as they watch and track your moves on their whiteboards.

- Set both game markers at the beginning of the path, not yet on the 1 but slightly off the board.
- Spin the spinner and report the result to the students. Move your marker by the designated amount in a single jump rather than counting the steps one by one.
- Have your partner take a turn.
- Spin the spinner for your second turn and report the spin to the class. Remind students where you are right now and challenge them to figure out where you'll land if you move the amount indicated on the spinner.
- Borrow a whiteboard and pen from one of the students and write an equation to represent the situation—the number on which you presently sit, the number you spun, and the total. Ask students to do the same on their boards and hold them up to show.
- Then make your move.
- Have your partner take his second turn. This time, have students write an equation to represent the situation and hold up their boards to show without modeling it for them.



Administer Unit 7 Assessment:
Complete practice problems and review together. Read directions aloud and allow students to work independently.



Unit 7 Assessment page 1 of 3

1 Write the number that belongs in each empty box. Use the clues on the paths to help.

KEY
Bread crumb every 1 step
Pinecone every 5 steps
Pebble every 10 steps

a

51

b

83

Week Four: While this week's lessons use money as the basic manipulative, and students have many opportunities to count collections of coins, the mathematical focus is squarely on place value—counting, comparing, and adding quantities to 120. Students count pennies into groups of 10, and 10s into a group of 100. They also record, add, and compare amounts of money (pennies, nickels, and dimes), with special emphasis on comparing based on the meaning of the tens and ones digits. Students get an opportunity to estimate, as well as an introduction to coordinate grids.

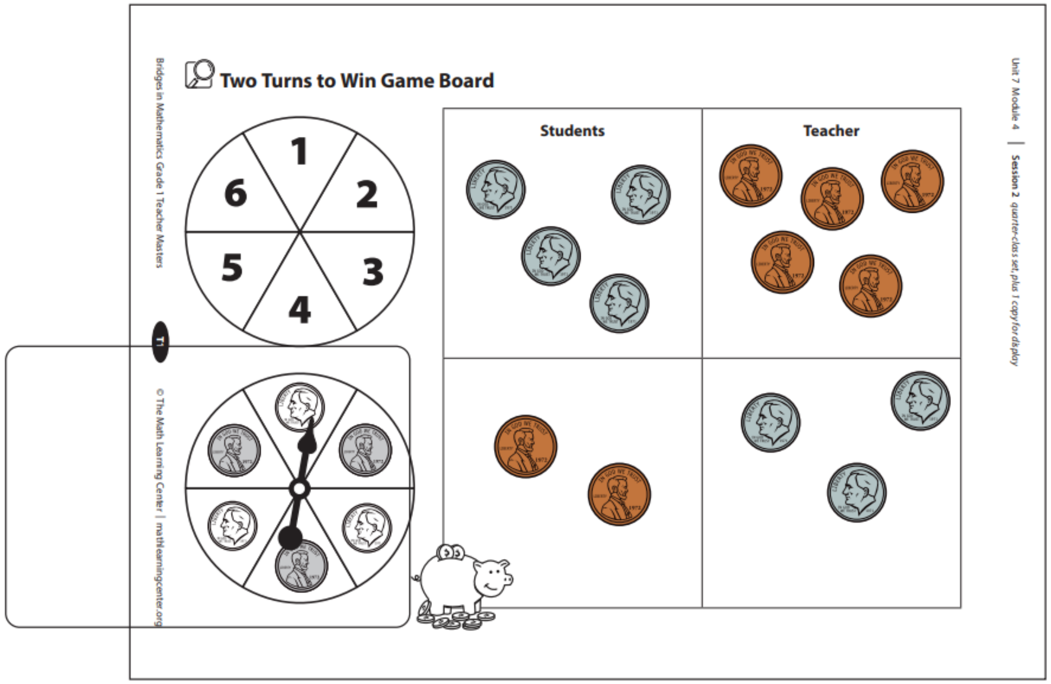
Students will estimate and then count by 10s a large group of pennies:
Show students the jar of pennies you've prepared and hold it up for a few moments. Ask them to think quietly about how many pennies are in the jar. Record their estimates on a piece of chart paper or on the whiteboard, encouraging them to explain their thinking. If two or more students volunteer the same estimate, underline that number on the chart as many times as necessary.

Pour the pennies out of the jar and spread them out a little. Invite students to adjust their estimates and add the new estimates to your chart. With the class, count about half of the pennies into groups of 10, and place each group in a portion cup. Ask students if there are any numbers on the chart that don't seem reasonable now and could be crossed off. Have them explain their reasoning, and cross off those numbers.

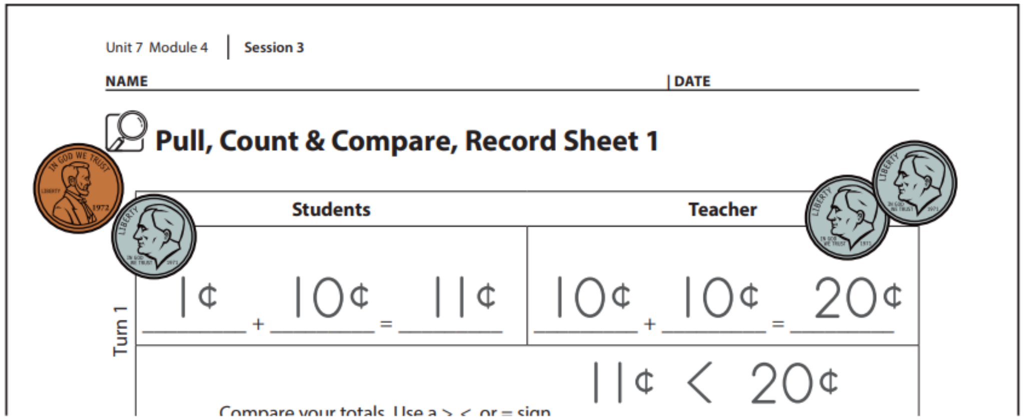
Count the rest of the pennies into groups of 10 with the class. Work with input from the students to count the portion cups by 10s to 100, emptying each cup into a margarine tub or other small container. Once you've reached 100, place the two extra portion cups next to the tub. Ask students how many pennies there are in all and have them explain their reasoning.

Students will count and add pennies and dimes while playing *Two Turns to Win*:
Introduce the session by displaying a copy of the Two Turns to Win Game Board Teacher Master and asking for observations.

- Explain that in this game they will spin to see how many dimes and pennies they can collect for their team.
- Playing will give them more practice with adding and counting money.
- You will play against the class, and then they will play in small groups.



Students will add groups of pennies and dimes and compare the sums while playing *Pull, Count & Compare*:
Introduce the session by holding up a paper sack with pennies and dimes in it and giving it a couple of shakes. Tell students there are pennies and dimes in the bag. Explain that in this game teams will pull coins out of the bag, add them together, and compare totals. You will play against the class and then they will play in pairs.


Unit 7 Module 4 | Session 3

NAME | DATE

Pull, Count & Compare, Record Sheet 1

	Students	Teacher
Turn 1	1¢ + 10¢ = 11¢	10¢ + 10¢ = 20¢
	Compare your totals. Use a >, <, or = sign	11¢ < 20¢

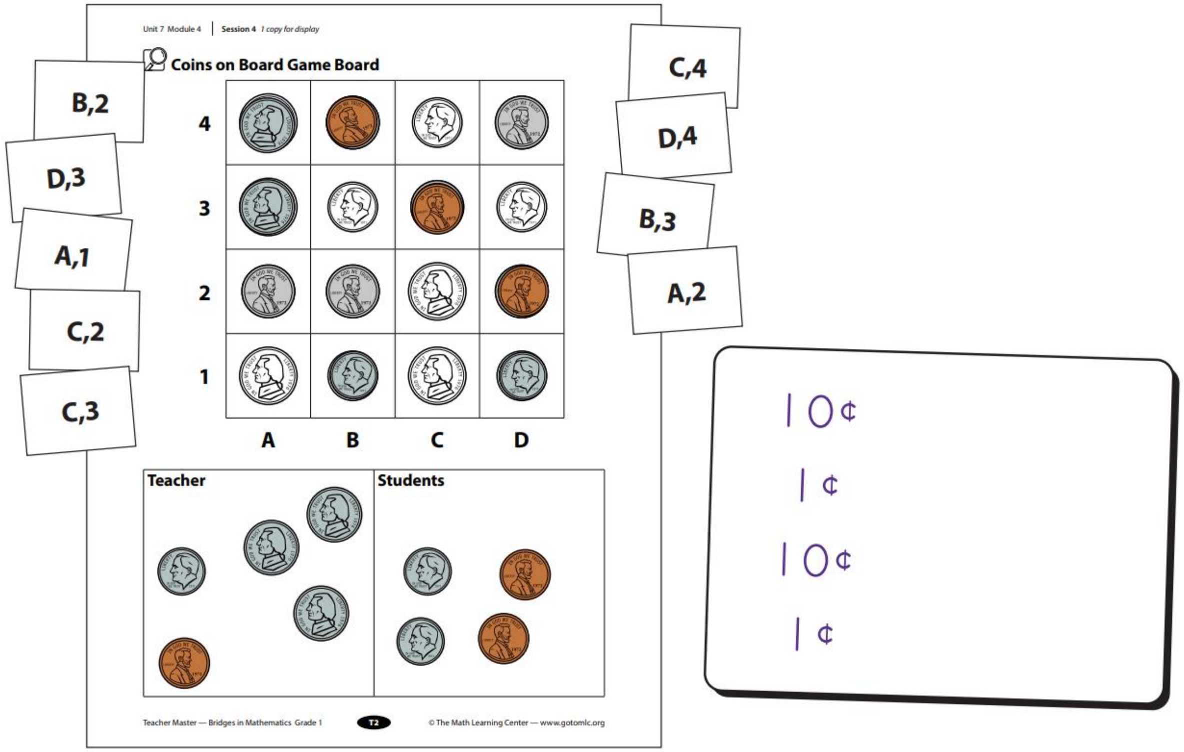
Students will review the value of pennies, nickels and dimes, and add groups of the coins while playing *Coins on Board*:
Introduce the session by displaying the Coins on Board Game Board Teacher Master and asking students to share their observations.

- Explain that you're going to work together to set a plastic coin on top of each coin pictured on the board.
- Once the coins are laid out, the class will play as a team against you.
- The coordinate cards will determine the coins each team gets to capture. The team that captures the most money wins.

Before setting out the coins, show students how to read coordinates and locate them on the grid.

- Pull a coordinate card out of the envelope, displaying and reading it.
- Help students find that coordinate square on the board and identify the coin pictured in the square. For example, if a card reads "C,2" run your finger across to column C and then up to row 2, landing on a nickel.
- Then have a volunteer set the appropriate coin directly on top of the pictured coin.
- Continue in this way until the students have located four or five coordinate squares on the grid and set the appropriate coins on top of the ones pictured in each of those squares.

Play back and forth, writing the value of each succeeding coin as it is captured.



Interdisciplinary / Real World / Global Connections

- Counting by 5s and 10s can be useful when counting large quantities of objects in the real world.
- The *Hansel and Gretel* activities show how mathematics can be applied to solve real world problems (measurement, skip counting, problem solving).
- Counting coins (pennies, nickels, dimes) is a real-world skill that also reinforces counting by 1s, 5s and 10s.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively

☐ Writing effectively for a variety of purposes

☐ Presenting ideas accurately with the support of engaging media

☒ Thinking critically to solve problems and reach well reasoned judgments

☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See “Game Variations” in workplace guides
- See “Assessment and Differentiation” in workplace teacher masters

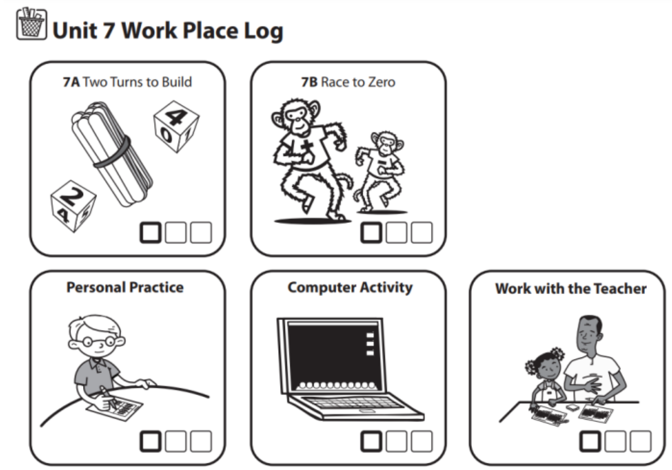
English Language Learners (ELL):

- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments
Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 7 Numbers to 120 Checkpoint

Numbers to 120 Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Identifies and records the value of points on a number line given visual and number clues *30, 33, 39*	1.NBT.1 1.MP.1	**3 pts.** • 1 pt. for each correct answer	
1b Identifies and records the value of points on a number line given visual and number clues *57, 65, 68, 74*	1.NBT.1 1.MP.1	**4 pts.** • 1 pt. for each correct answer	
2 Identifies whether certain points on the number line are multiples of 1, 5, or 10, based on visual and number clues *PC, P*	1.NBT.1 1.MP.1	**2 pts.** • 1 pt. for each correct answer	
3 Solves addition problems within 100 (multiple of 10 plus multiple of 10 and 1-digit plus 2-digit combinations) *30, 60, 35, 48*	1.NBT.4	**4 pts.** • 1 pt. for each correct answer	
4 Solves subtraction problems within 100 (multiple of 10 minus multiple of 10) *10, 20, 40, 40*	1.NBT.6	**4 pts.** • 1 pt. for each correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**17 pts.**	

* **5–17 points:** Working at Tier 1 or Tier 2 Level
4 points or fewer: May need Tier 3 Support

- Unit 7 Post-Assessment

Unit 7 Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–c Identifies and records the value of points on a number line given visual and number clues *a 60, 63, 70; b 90, 93, 99; c 96, 105, 108, 114*	1.NBT.1 1.MP.1	**10 pts.** • 1 pt. for each correct answer	
2 Adds 5 to 47. Shows work. *52; students' work will vary*	1.NBT.4	**3 pts.** • 1 pt. for the correct answer • 1 or 2 pts. for showing work (award 1 pt. for a count all or count on strategy; award 2 pts. for any strategy more sophisticated than counting on)	
3 Adds 20 to 52. Shows work. *72; students' work will vary*	1.NBT.4	**3 pts.** • (see scoring notes for item 2 above)	
4a Writes and solves an equation to represent a situation that involves combining 5, 2, 1, 1, 5, and 10. *24; students' equations will vary*	1.OA.1 1.OA.2 1.OA.3	**1 pt.**	
4b Writes and solves an equation to represent a situation that involves combining 1, 1, 1, 1, 1, 1, 2, 2, and 5. *15; students' equations will vary*	1.OA.1 1.OA.2 1.OA.3	**1 pt.**	
5 Solves addition problems within 100 (multiple of 10 plus multiple of 10 and 1-digit plus 2-digit combinations) *30, 48, 77, 46*	1.NBT.4 1.NBT.5	**4 pts.** • 1 pt. for each correct answer	
6 Solves subtraction problems within 100 (multiple of 10 minus multiple of 10) *20, 30, 30, 45*	1.NBT.5 1.NBT.6	**4 pts.** • 1 pt. for each correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**26 pts.**	

* **Meeting Standard** 20–26 points (75%–100% correct) **Approaching Standard** 13–19 points (50–74% correct) **Strategic** 7–12 points (25–49% correct) **Intensive** 6 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Grade 1, Mathematics Curriculum

Subject(s)	Math
Grade/Course	Grade 1 / Mathematics
Unit of Study	Unit 8: Changes, Changes
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique reasoning of others. 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** **7. Look for and make use of structure.** 8. Look for and express regularity in repeated reasoning. **Priority/Focus Standards:** 1.OA.6 Add and subtract within 20 1.OA.6 Use the relationship between addition and subtraction to add and subtract within 20 1.NBT.1 Count to 120, starting with any number less than 120, including 0 or 1

1.NBT.1 Read and write numerals to 120 1.NBT.1 Represent a number of objects with a written numeral up to 120 1.NBT.3 Compare pairs of 2-digit numbers 1.NBT.4 Add a multiple of 10 (up to 80) and another 2-digit number 1.NBT.4 Use concrete models or drawings and strategies based on place value, properties of operations, or the relationship between addition and subtraction to add with sums to 100 1.NBT.5 Mentally find the number that is 10 more or 10 less than a given 2-digit number, without counting, and explain the reasoning used 1.NBT.6 Subtract a 2-digit multiple of 10 from an equal or greater 2-digit multiple of 10 1.MD.1 Order 3 objects by length 1.MD.1 Compare the lengths of 2 objects indirectly by comparing the length of each to a third object 1.MD.2 Measure the length of an object by laying multiple copies of a shorter unit end to end (iterating) 1.MD.2 Express the length of an object as a whole number of units 1.MD.2 Demonstrate an understanding that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps 1.MD.3 Tell and write time to the hour and half-hour on an analog and a digital clock 1.MD.4 Organize, represent, and interpret data with up to 3 categories 1.MD.4 Answer questions about the total number of data points in a set of data, how many data points are in each category, and how many more or fewer data points are in each category in a set of data with up to 3 categories 1.G.3 Partition a circle [rectangle] into 2 equal parts, and use terms to talk about the 2 equal parts **Supporting Standards:** 1.OA Recognize, describe, extend, and create number patterns

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Use direct comparison to determine the lengths of objects that are longer/shorter.	1. Length is an attribute that can be compared. 2. Events occur at different times.

2. Identify events that occur today, tomorrow, or yesterday; identify events that occur in the morning and the afternoon, day, and night. 3. Read digital and analog clocks to the hour and half-hour. 4. Identify data; categorize or group information by similarity. 5. Indirectly measure objects by comparing the length of two objects by using a third object as a measuring tool. 6. Use non-standard objects to measure.	3. There are 60 seconds in a minute. 4. There are 60 minutes in an hour. 5. Data can be arranged in categories. 6. Sometimes, lengths are not known, but the relationships between the three objects are known. This concept is known as the transitivity principle for indirect measurement.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can you measure objects by length? 2. How can time be shown on a clock? 3. How do I know what is going to happen at different times of the day? 4. How does data help me answer questions?	1. Length can be measured with repeating units. 2. Digital and analog clocks use numbers and hands to show time. 3. Many events occur at the same time each day. 4. Relevant information (data) can be sorted and analyzed to solve problems.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: *When using Tech-Enhanced Activities (TEAs), the following standard will be used.* **Standard 1.5.b**: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
Informational Texts: • **Informational Books:**

- Telling Time: How to Tell Time on Digital and Analog Clocks
    - Time Books
    - Patterns
    - Two of Everything
    - Ants Rule: the Long and Short of It
    - Measurement Books
    - Measuring Penny

MLC Apps:

- Interactive Teaching Clock
- Interactive Time Telling Games
- Match Analog and Digital Clocks Game
- Time Travel: Learn to Tell Time
- Adding 10 Depth Charger
- Grouping and Grazing Activity
- Raceway Number Values Game
- Money Pieces App

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Add: to combine; to put together two or more quantities.
Compare: to examine in order to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other.
Count: to name units in a group one by one in order to determine the total number; counting tells how many objects are in a set.
Cube: a three-dimensional shape (solid) whose 6 faces are all squares.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Edge: the line segment along which 2 faces of a three-dimensional shape (solid) meet.
Equal: of exactly the same amount or value.
Greater Than: a symbol used to indicate that the number on the left is greater than the number on the right.

Half: one part when a number, shape, or set is divided into exactly two equal parts.
Hour (hr.): a unit of time equal to 60 minutes (there are 24 hours in one day).
Hundreds: the numbers 100 to 999; also refers to the hundreds place.
Less Than: a symbol used to indicate that the number on the left is less than the number on the right.
Long/Longer/Longest: having considerable length / having a length that is more than that of another object / having a length that is the greatest of three or more objects.
Minute (min): unit of time equal to 60 seconds or 1/60 of an hour.
Number Line: a diagram in which numbers are represented as points on a line.
Ones: the numbers 0 to 9; also refers to the ones place.
Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement.
Rectangle: a two-dimensional (flat) shape with 2 pairs of parallel sides (4 sides total) and 4 right angles.
Second (sec): a unit of time equal to 1/60 of a minute.
Short/Shorter/Shortest: having small length / having a length that is less than that of another object / having a length that is the least of three or more objects.
Subtract: to take one quantity away from another or find the difference between two quantities.
Sum or Total: the result of adding two or more numbers.
Tens: the numbers 10 to 99; also refers to the tens place.
Weight: a measure of how heavy an object is.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

During Unit 8, students consider the concept of change from several different angles. The activities in Week 1 help first graders make the link between time and change as they investigate some of the changes, they can make to materials such as paper, craft sticks, and ice cubes in a second, a minute, and an hour. In Week 2, they explore predictable changes in numbers, using a very simple function machine made of a half-gallon milk carton and specially designed sets of change cards. In Week 3, students consider changes in location as they learn to fold and launch paper gliders through the air. After making and testing an initial set of gliders, students modify their original gliders or fold new ones in the attempt to better their flight distances. In Week 4, they explore some of the ways they've grown and changed since they were born. All in all, Unit 8 offers a satisfying end to the school year, blending math and science in ways sure to engage young learners.

Week One: The first three sessions of Week 1 are all about developing a sense of time and its passage. In first grade, students have learned to tell time to the hour and half-hour, and in second grade they will learn to tell time to the nearest five minutes. But what exactly does that mean? How long is a second, a minute, an hour? These sessions offer rich opportunities to experiment with each unit of time, so students begin to develop a sense of duration. The game played in the last two sessions has students counting by 5s on the clock, comparing 2-digit numbers, and adding 2-digit numbers using the clock face, manipulatives, or mental calculation.

Students will conduct experiments to find out how long a second and a minute is:
Introduce the session by letting students know that they'll be studying time and change over the next few weeks. Ask students to pair-share at least one thing they know about time, and then call on volunteers to share their ideas with the class.

Write the following words on the board or a piece of chart paper as students watch: *second, minute*. Read these with the students and explain that seconds and minutes are units people use to measure time. Let the students know that you're going to do some experiments today to find out how long each one takes.

Have students try some experiments to see what they can do in a second. Have students snap their fingers in time to the ticking of the clock. Does that speed feel about right, or does it seem like they could snap more than once per second? Repeat the experiment with clapping and then blinking.

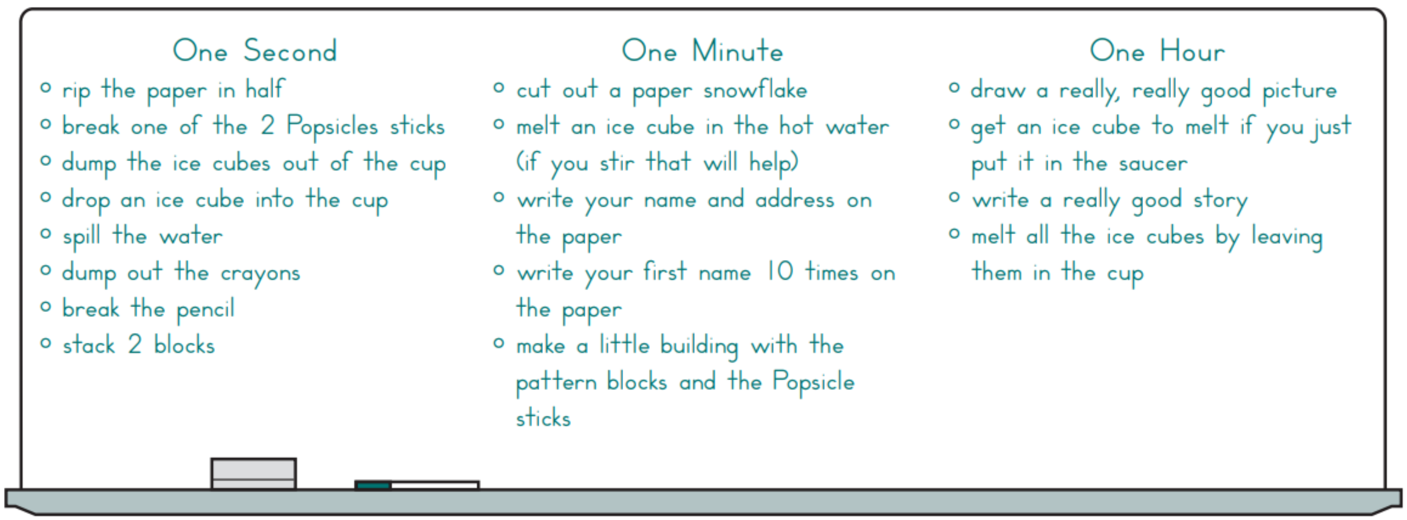
Now have students try some experiments to see how long a minute is.
- Have the class watch the classroom clock without making a sound for 1 minute. Discuss: How many seconds passed? Did a minute seem short or long to them?
- Demonstrate holding your arms outstretched on either side, so your body looks like the letter T. Have the class stand up and try it, without talking, for one minute. Tell them that if they must put their arms down and rest before a minute passes, that's OK. At the end of the minute, ask students to discuss the experience: Did a minute seem short or long this time?
- Have students estimate, and then find out, how many times they can write their first name in one minute.

Students experiment to determine how long certain actions would take—a second, a minute, or an hour:
Prepare the following items:
- 15 pattern blocks in a small container
- 4 or 5 ice cubes in a cup
- a small clear container of very hot water
- a saucer

Draw students' attention to the container of pattern blocks, and ask how long they think it will take you to stack all 15 blocks—a second, a minute, or an hour? When the second hand on the classroom clock reaches the 12, have students watch the clock as you stack the blocks. Discuss the results when you're finished.

Now ask students how long it will take—a second, a minute, or an hour— for someone to knock over the stack. Have them whisper their predictions to the people sitting next to them. Have students watch the clock as your volunteer knocks over the stack, and then discuss.

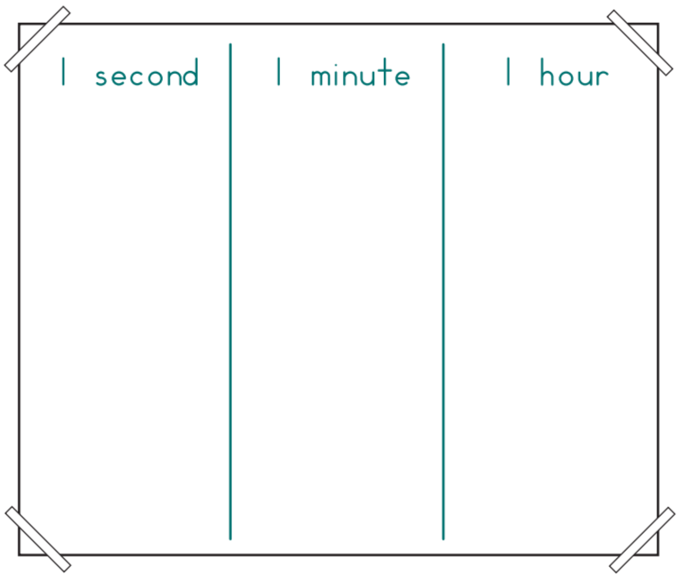
Point out that both of these experiments involved changing the materials in some way: (You took the pattern blocks out of their container and stacked them, your helper knocked the stack over.) Now ask students to brainstorm some other 1-second, 1-minute, and 1-hour experiments you could try using only the materials on the tray and record their suggestions on the board.

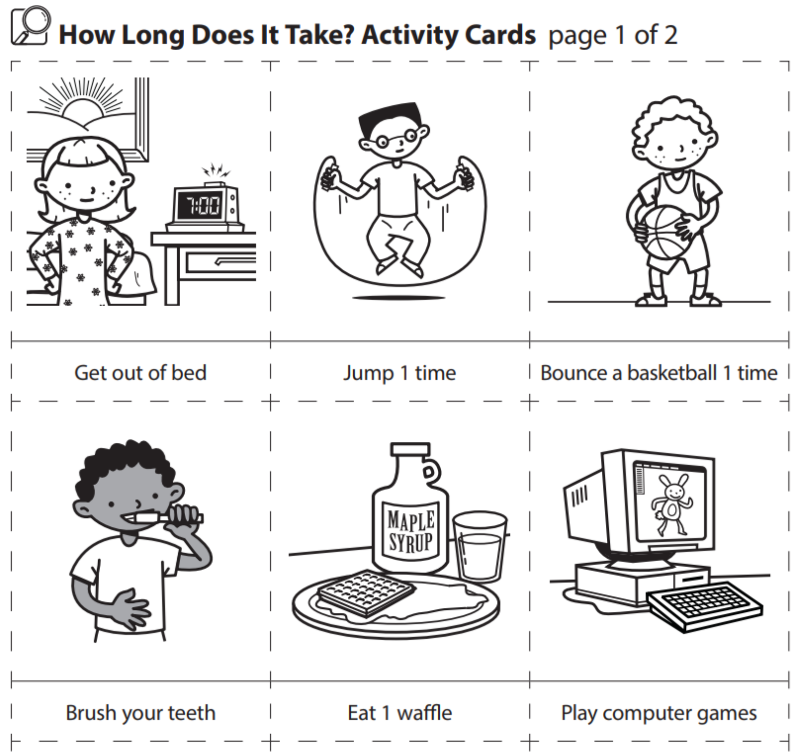


Invite students to try some of the 1-second and 1-minute suggestions as their classmates watch and time them. Place a star beside the suggestions that take the predicted amount of time (or close to it).
Set up both ice cube experiments and record the starting time on the whiteboard. Appoint an official "watch person" to keep an eye on the ice cubes. Record the time when the cube on the saucer is finally all melted. Do the same for the cup of ice cubes. Then work with students to calculate the amount of time it took in both cases.

Students sort a collection of pictures by the amount of time it takes to do each activity shown:

Have students locate the two sheets of How Long Does It Take? Activity Cards in their Student Books. Explain that their job will be to cut out all 18 cards and sort them according to the amount of time it takes to do each activity pictured on the cards. Be sure they understand these times are only approximate. It might actually take them 2 minutes to make their bed or 45 minutes to get ready for bed and read a bedtime story, but it takes closer to a minute than an hour to make their bed, and closer to an hour than a minute to get ready for bed.



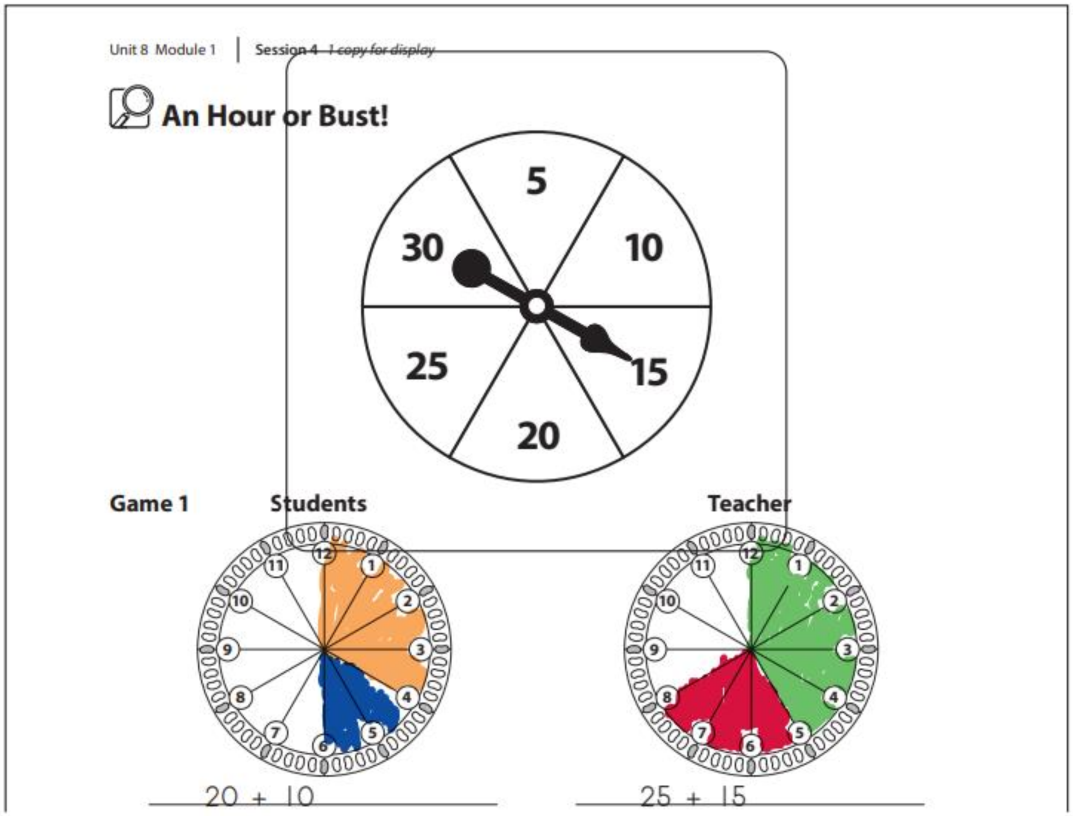


Students will observe the multiples of 5 on an analog clock while playing *An Hour or Bust!*

Display a copy of the Hour or Bust Teacher Master. Note with the students that starting after the first dark bean at the very top of the clock, there are 4 white beans and then a dark bean, and the pattern continues around the clock. Starting with the first white bean after the 12, count all the beans around the clock by 1s with the class. Have students whisper the white bean numbers and call out the dark bean numbers 1, 2, 3, 4, FIVE; 6, 7, 8, 9, TEN; 11, 12, 13, 14, FIFTEEN, and so on until you've reached 60. Then go back and touch each of the dark beans around the clock as students count by 5s with you.

Briefly describe how the game is played:

- In this game you'll race to see who can come closest to coloring in a whole clock face (an hour) without going over 60 minutes. You will be one team and the class will be the other.
- Students will keep track of the class score as the game goes along, and you'll be keeping score for both teams.
- Each team must take at least two turns and can take two more turns after that if they choose.



Week Two: Week 2 is an introduction to patterns and functions, two of the “big ideas” of algebra, using a function machine. Students are introduced to the concept of functions through a story in which a picnic basket doubles everything that goes into it. The other three sessions have the class using a teacher-made function machine (Change Box) and Change Cards to explore various number patterns. Students record input and output numbers on a T-chart and determine rules for the patterns. These activities also provide opportunities to practice addition and subtraction of a single digit as well as 10s.

Students will double numbers in the context of a story about a magic basket:
Read the following story to the class. Add details or change names to suit yourself and your students if you like:

Sara and her little brother, Sammy, were spending the week in the country with their grandma. The two children were bored. They had played every game and read every book in the house, and they couldn't think of anything to do.

Finally, Grandma said, "Sara, why don't you look upstairs in the attic? I think you'll find my old picnic basket up there somewhere. You and Sammy can pack a nice lunch in that basket and take it out under the big tree down by the stream. I'm going over to the neighbor's house for a while, but you know where to find everything you'll need in the kitchen, right?"

"Right, Grandma! I'll take care of it!"

Sara ran upstairs to the attic. It was hot, dark, and dusty, but Sara was determined to find the basket. She looked everywhere, and finally found it in a corner under a pile of old blankets. She grabbed it, ran back down the stairs, set it on the kitchen table, and started making sandwiches.

Sammy came running into the kitchen. "What's that, Sara?"

"It's a picnic basket. I'm packing a lunch for us to take down to the big tree. I already put a peanut butter sandwich in there for you."

"Can I see?" Without waiting for Sara's reply, Sammy lifted the lid and peered into the basket.

"How come there are two peanut butter sandwiches in there? I thought you didn't like peanut butter!"

Sara frowned. "I don't like peanut butter, and I only put one sandwich in there."

"But come look! There are two sandwiches in here!"

"I don't know what you're talking about, Sammy. Here, put these two apples in the basket, will you?"

Sammy took the two apples from Sara and put them in the basket. He closed the lid and waited a moment. He had a funny feeling about this basket. He opened the lid again and saw not two, but four apples sitting inside. He grabbed some of the napkins that were sitting on the table, counted them carefully—1, 2, 3—put them into the basket, closed the lid, and opened it again. He reached inside slowly and carefully, took the napkins out, and counted them again. There were 6 of them now.

"Sara … this is really weird!" he said.

"What are you talking about?" Sara whirled around and saw two sandwiches, four apples, and six napkins sitting on the table next to the basket.

"What are you doing? Where did that stuff come from?"

"It's this basket! It makes more things. If you put something in, you get more out!"

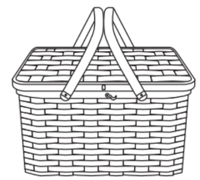
"That's impossible! This is one of your tricks, isn't it?"

"Try it for yourself and see!"

Sara glanced over at the counter and saw four oranges in a bowl. She grabbed the bowl, dumped the oranges into the basket, closed the lid, slowly opened it again, and pulled out eight oranges.

Sammy ran out of the kitchen and came back with five of his favorite matchbox cars. "Let's see if it works with things you can't eat, like my toy cars." He dropped the little cars into the basket, closed the lid, waited for a second, opened it again, and started pulling out one car after another—1, 2, 3, 4 …

Ask the students to predict how many toy cars Sammy pulled out of the basket. Help the students test their theories by reviewing the story (or rereading it if necessary) and working with their help to list on the chart the numbers of objects that went into the basket and the numbers that came out.



IN	OUT
1 sandwich	2 sandwiches
2 apples	4 apples
3 napkins	6 napkins
4 oranges	8 oranges
5 toy cars	

Continue with the story:

… 5, 6, 7, 8, 9, 10. Sammy pulled out 10 cars in all.

"It works, Sara! It works with toys! What if we put something alive in there, like … " Sammy pulled the basket down onto the floor, opened the lid, and started to step into it.

"Stop!" yelled Sara. "Don't you dare get into that basket! One of you is more than enough! Shut that lid right now! We have to think about this before we put anything else in."

Sara stared out the window, trying to figure out what to do.

Meanwhile, Sammy slipped out the back door and returned with an armful of kittens—10 to be exact—wrapped up in a blanket. The two mother cats trotted along behind him, concerned about their babies.

Stop reading and discuss the situation with the students. If Sammy puts 10 kittens in the basket, what will happen? How many kittens will come out of the basket? How do they know?

Read the rest of the story to the class:

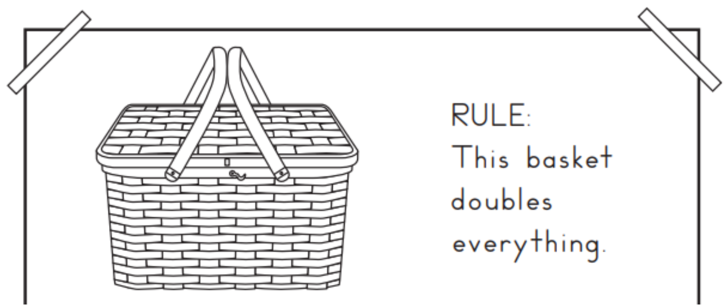
Grandma stepped into the kitchen at that very moment. She took one look at the sandwiches, apples, napkins, oranges, and toy cars scattered all over the kitchen table, Sam holding the blanketful of kittens over the open basket, and Sara, who was screeching at Sammy to stop—and started laughing.

She took the blanket out of Sam's arms and set it gently on the floor. She sat down, pulled Sammy and Sara into her lap and said, "My, my … what a time you've had while I was gone. I've always wondered if the old Doubling Basket would really work."

"You mean, this isn't the picnic basket?" cried Sara.

"No, honey. I should have gone up to the attic with you. The picnic basket is hanging up on the wall, probably too high for you to see. My grandma gave me the Doubling Basket many years ago. She told me to keep it safe, but not to use it unless I absolutely had to. It's been in our family for more than 100 years and so far, we've never needed to use it. I guess I should have found a better place to hide it."

Now ask students to come up with a rule for what happens to the items that go into the basket and record it at the top of the chart beside the picture of the basket.

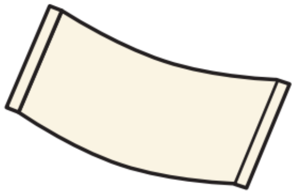


Students will predict a function based on input and outputs while playing with the *Change Box*:

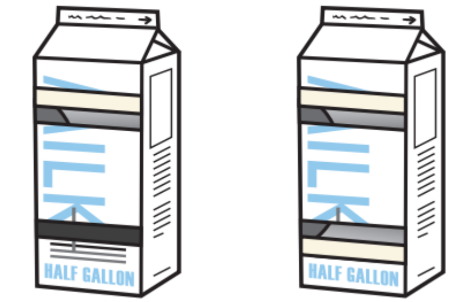
Use a clean, dry half-gallon milk carton (or any closed cardboard box of a similar size) to make a "Change Box" — a simple function machine.

- Cut out two rectangular slots, each 3 ¼″ × ¾″, horizontally on the front of the carton, one near the top and one near the bottom.

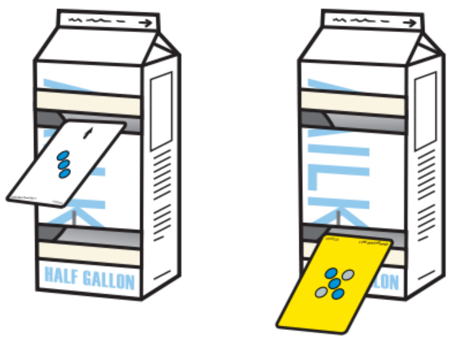
- Cut out a "slide" (3″ × 8″) from tagboard or card stock. Fold back about half an inch at the top and the bottom of the strip.



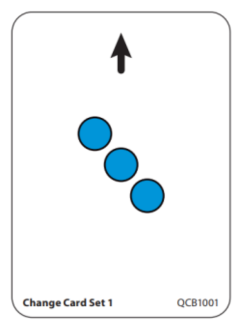
» Insert the slide through the top slot and tape the part you've folded back to the outside top edge of the slot. Reach in and pull the slide out through the bottom slot, and tape the folded part to the outside bottom edge of the slot. The slide should form a gentle curve inside the box.

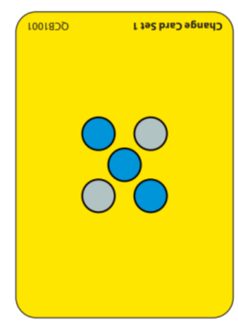


» Change Cards will go in the top slot, slide on the slide, and pop out the bottom slot with the reverse side showing.



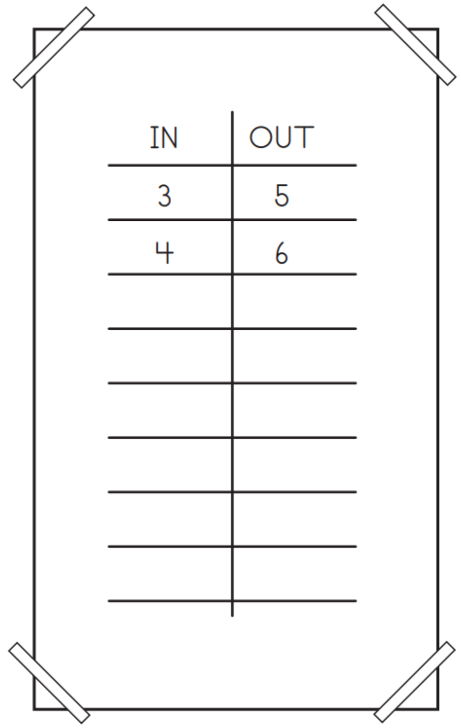
Show students the milk carton function machine you prepared and tell them this is a special box that can change things. Show students the front of one of the Change Cards, Set 1, and have them discuss what they see.
Insert the card face-up in the top slot of the Change Box and then show students what pops out at the bottom. What kinds of changes have occurred?



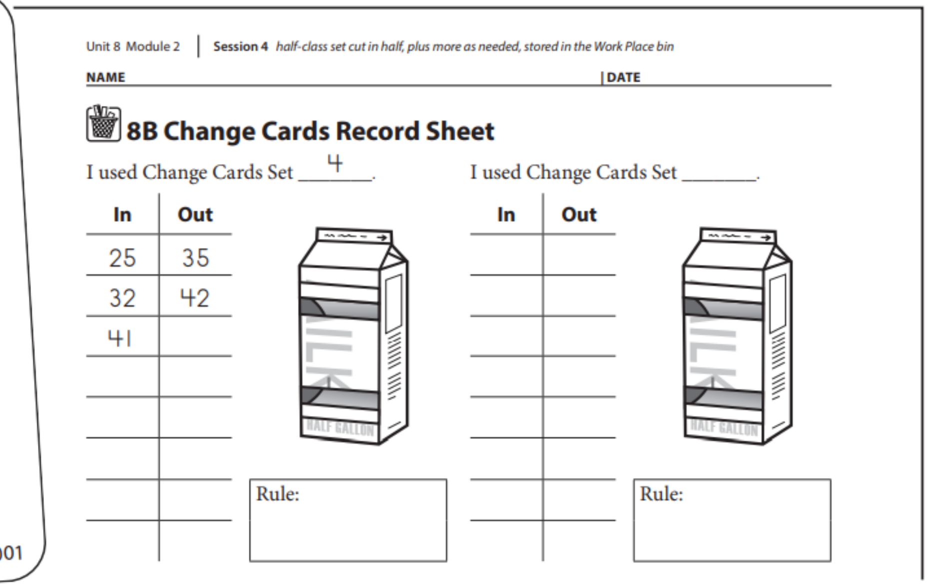


Do the same with several more of the cards in Set 1, and then start asking students to predict what will come out of the box. Give students a few moments to pair-share their predictions for each card. Call on two or three volunteers to share and explain their predictions each time.

Show students how to make a simple T-chart on their whiteboards and to write the word “In” on the left side and the word “Out” on the right side. Using two cards from the set again, have students count and record the number of dots that go into the box on the left side of their charts and the total number of dots that come out of the box on the right side.



Students will predict functions again using the *Change Box*, but this time the change cards will have numbers instead of dots:
The student selects a set of Change Cards to put in the Change Box. Each card in a given set shows one number when it goes into the box and comes out showing a different number. The student records the input and output numbers on a T-chart and determines the “rule” for that set of cards.


Unit 8 Module 2 | **Session 4** *half-class set cut in half, plus more as needed, stored in the Work Place bin*

NAME | DATE

8B Change Cards Record Sheet

I used Change Cards Set 4.

In	Out
25	35
32	42
41	

Rule:

I used Change Cards Set ________.

In	Out

Rule:

Administer the Time and Change Checkpoint:

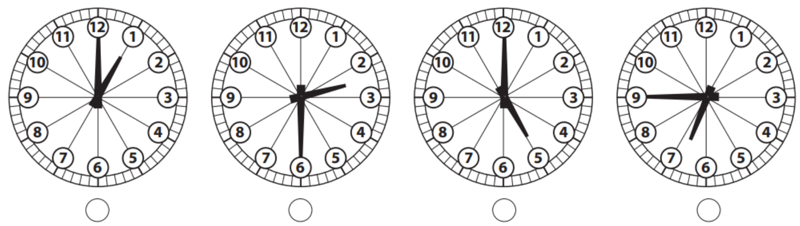
- Read and explain the instructions for each problem.
- When students understand what to do, let them go to work.
- Circulate as they work to assist as needed. Let students know that it’s fine to raise their hand and ask you to read one or more of the problems to them again.

Time & Change Checkpoint page 1 of 2

1 Sara brushed her teeth after breakfast. Fill in the bubble to show how long it probably took.

- ○ 1 second
- ○ 1 minute
- ○ 1 hour

2 Danny went to soccer practice at 4:00. His practice lasted for 1 hour. Fill in the bubble under the clock that shows what it looked like when soccer practice was over.

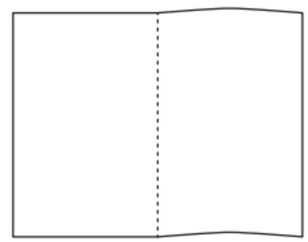


Week Three: Week 3 offers a full-fledged science project: students learn to fold and fly simple paper gliders, construct Unifix cube trains to measure flight distances, and create tally charts to show the flight data collected by the entire class. The teacher then invites students to modify their original gliders or make new ones with the intent of improving their flight distances. They collect and analyze a second round of data to see whether their glider modifications made any difference.

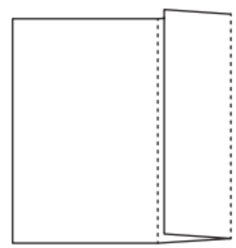
Students will make paper gliders to use throughout the week to measure distance and change:

As students watch, model the process of folding a paper glider as shown and described below.

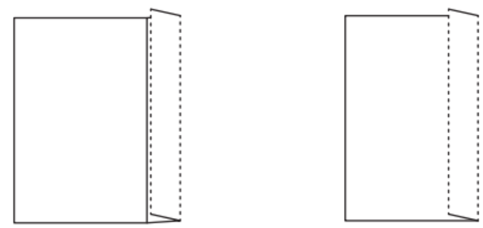
- Fold the half-sheet of paper in half widthwise.



- Open your paper up. Fold one side in half again, so the edge meets the center line.



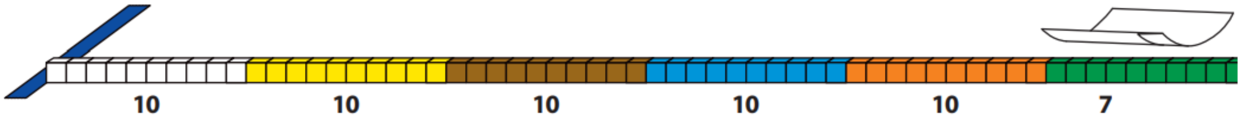
- Fold that same piece over again, into the center line. Then fold the entire folded section over the center line.



- With the folded side up, create a curve in the paper by sliding it back and forth over a table edge.

Once you have folded the paper glider, show the students how to make it fly. Hold the glider at about shoulder level with the folded part forward and underneath. Release it gently; don't push it forward. It should sail a good distance before it lands. If it just falls to the floor, try again. If it sails a little and then curves off to one side or the other, ask students to suggest adjustments you might make to get it to fly in a straight line. Explain that it might take some practice to get the glider to fly the way you want it to and reassure students that you'll give them time to do that once they've folded their own gliders.

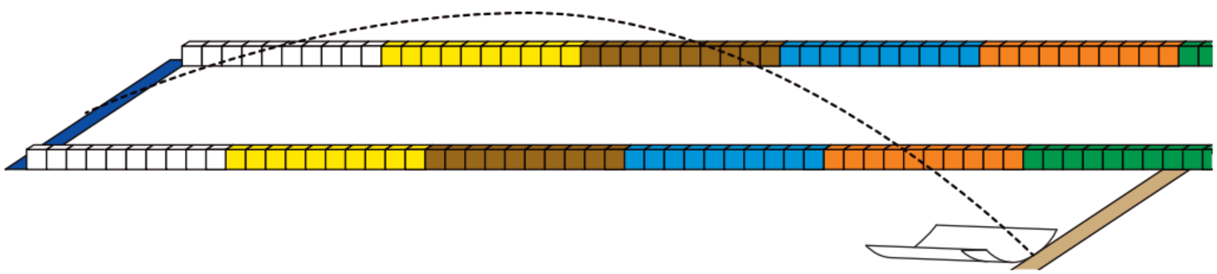
Students will count by 10s to 200 when making runways for their paper gliders:
Let students know that they will all have a chance to see how far their gliders can fly tomorrow. Propose using a long train of Unifix cubes to measure the flight distances, just as students did earlier in the school year to measure the lengths of various objects around the classroom. Explain that in a minute, you will divide the class into four groups, and each group will work together to build a train of 200 Unifix cubes. Solicit agreement from the students that making small trains of 10 and hooking them together would be easier and more efficient than trying to count out 200 cubes by 1s.



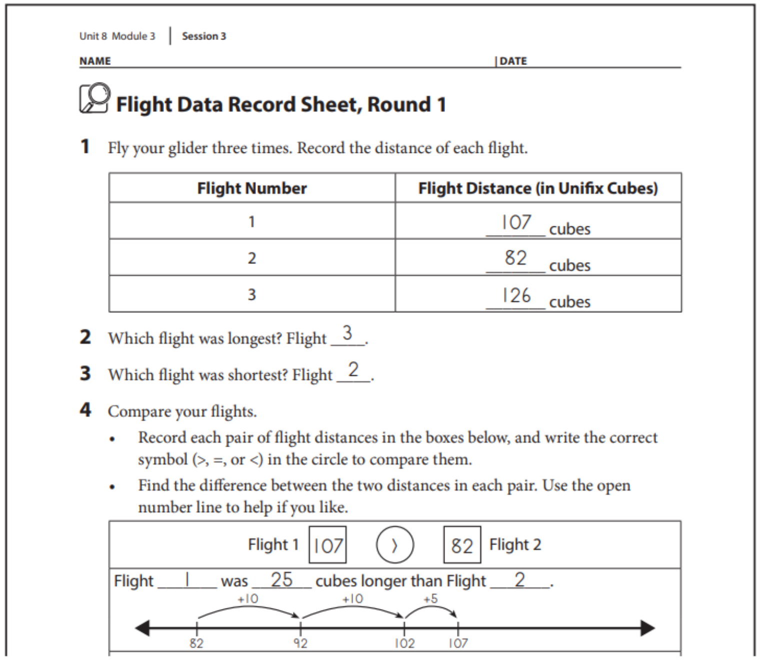
Students will measure and compare the length of their paper gliders' flight:
Have students join you in the discussion area. Explain that today they will each get three chances to fly their own glider, and they will measure and record the results of each flight on a data record sheet.

Model how to launch and then measure the flight distance of a glider.

- Stand with both feet behind the masking tape line.
- Hold your glider at about shoulder level, with the leading, folded edge of the glider aimed straight ahead, toward the runway.
- Gently guide the glider into flight, and let it float to the floor.
- If all goes well, the glider will land somewhere close to one of the runway strips. If your glider does a nosedive, landing within the first 30 cubes, repeat the launch. Let students know that nosedives don't count, and that any time their glider doesn't go a distance of at least 30 cubes, they get to make that flight over.
- Identify the Unifix cube that most accurately indicates the final resting point of the front of the glider.
- Work with the students to count the cubes in the strip nearest the glider by tens and ones to determine the distance flown.



Record the distance (in cubes) flown by the glider in the appropriate space on the Flight Data Record Sheet.



Unit 8 Module 3 | Session 3

NAME | DATE

Flight Data Record Sheet, Round 1

1 Fly your glider three times. Record the distance of each flight.

Flight Number	Flight Distance (in Unifix Cubes)
1	107 cubes
2	82 cubes
3	126 cubes

2 Which flight was longest? Flight 3.

3 Which flight was shortest? Flight 2.

4 Compare your flights.

- Record each pair of flight distances in the boxes below, and write the correct symbol (>, =, or <) in the circle to compare them.
- Find the difference between the two distances in each pair. Use the open number line to help if you like.

Flight 1 $\boxed{107}$ > $\boxed{82}$ Flight 2

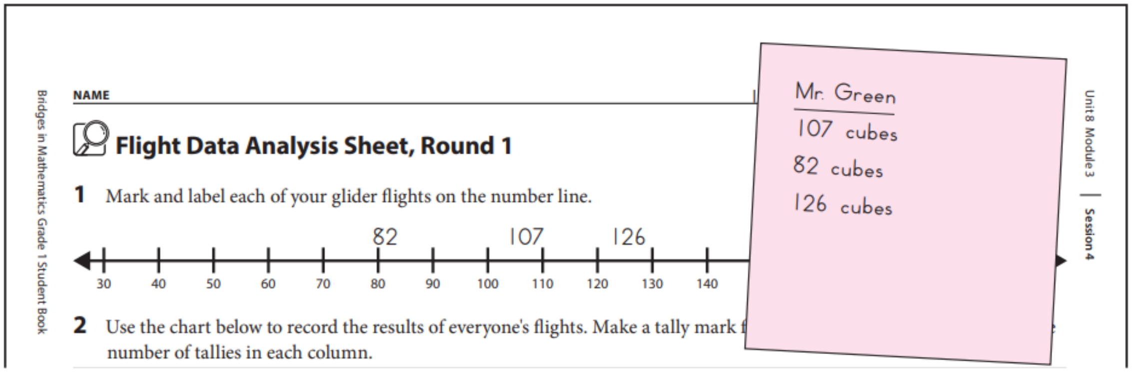
Flight 1 was 25 cubes longer than Flight 2.

Students will analyze the flight data from the previous lesson:
Let students know that you are going to work together to look at the flight data they collected last session.
Display your copy of the Flight Data Analysis Sheet. Give students a few moments to examine the sheet quietly, and then review it with them.

- Explain that the number line at the top of the sheet is a little bit like the 200-cube Unifix train they used to measure their flight distances last session. Note with students that the line begins at 30 rather than 0 because flights less than 30 cubes weren't recorded. (Anyone who made a flight less than 30 cubes long got to do it over.)
- Explain that you will use the chart in the middle of the page to find out how everyone's flights from last session turned out.

Use your sheet to model how to enter flight distances on the number line.

- Show students the sticky note you prepared with your three flight distances from the previous session.
- Work with input from the class to mark and label each of these flight distances on the number line.



Now explain that you're going to collect flight data from everyone in class and show it by making tally marks in the correct columns on the chart you just color-coded.

NAME ______________________________ | DATE ______________

Flight Data Analysis Sheet, Round 1

1 Mark and label each of your glider flights on the number line.

2 Use the chart below to record the results of everyone's flights. Make a tally mark for each one. Then count and record the number of tallies in each column.

70 cubes or fewer	71–110 cubes	111–150 cubes	more than 150 cubes
Total: 32*	Total: 20	Total: 18	Total: 14

3 Circle the lowest total. Put a star beside the highest total.

4 CHALLENGE How many flights did the class make in all? Add the totals to find out. Show your work.

The class made _______ flights in all.

Students will improve the design of their paper gliders:

Give students time to make adaptations to their gliders with the intent of improving the flight distances in a second day of trials.

- Quickly review how to fold a paper glider by modeling each step as the students watch.
- Have the class brainstorm ideas for modifying a new or existing glider so it will fly farther. Possibilities suggested by students (or by you) may include:
  - Changing the depth of the curve so it is either more shallow or deeper
  - Making additional cuts, holes, and folds
  - Adding weight to the sides with regular paperclips (You'll want to set a limit on how many clips you'll make

available to students who want to try this idea. We suggest no more than two per student.)
    - Taping or gluing on additional paper parts (wing extensions, extra flaps, and so on)
    - Changing the height from which the glider is released (Here, you'll need to decide about whether or not, and how, you want to allow students to release their planes from higher heights.)

- Make students' original gliders available, along with additional 5 1/2" × 8 1/2" copy paper rectangles and extra supplies such as scissors, single hole punches, tape, glue, and paperclips.
- Allow students time to problem solve—to adjust, to test fly the glider on one of the runways after the adjustments, and then to adjust again accordingly.

Students will measure and compare the length of their improved gliders' flight:
Explain that today the students will each get three chances to fly the improved glider they worked on last session. They will measure and record the results of each flight on the same kind of data record sheet they used for their last round of glider flights. Model the process of launching the glider, measuring, and recording the flight distance, and completing the Flight Data Record Sheet as necessary.

Flight Data Record Sheet, Round 2

1 Fly your glider three times. Record the distance of each flight.

Flight Number	Flight Distance (in Unifix Cubes)
1	________ cubes
2	________ cubes
3	________ cubes

2 Which flight was longest? Flight ____.

3 Which flight was shortest? Flight ____.

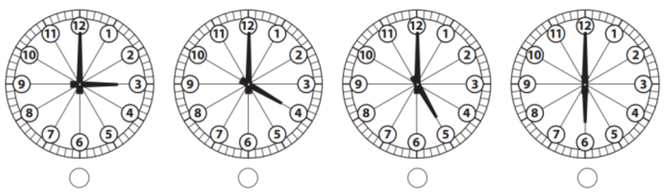
4 Compare your flights.

Unit 8 Assessment page 1 of 3

1 Sara brushed her teeth after breakfast. Fill in the bubble to show how long it probably took.

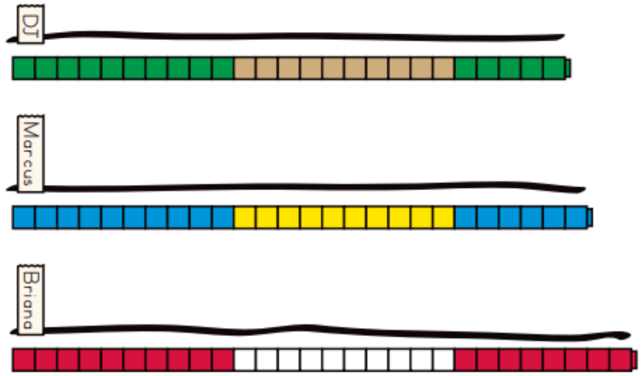
- ○ 1 second
- ○ 1 minute
- ○ 1 hour

2 Danny went to soccer practice at 4:00. His practice lasted for one hour. Fill in the bubble under the clock that shows what it looked like when soccer practice was over.



Administer Unit 8 Assessment:
Complete practice problems and review together. Read directions aloud

and allow students to work independently.
Week Four: In the final activities of the year, students investigate some of the ways they've changed and grown since birth. Much of the work revolves around comparing, measuring length in nonstandard units, and using various strategies to find differences between pairs of lengths. During the last session, the students take a gallery walk to view life timelines they created at home. The final activity brings Unit 8 around full circle to the relationship between time and change, as students consider some of the ways they might change in a minute, a day, or a year. **Note** To do the activities this week, students will need to have completed the Home Connections pages 129-13. In the first of these assignments, they'll have cut a piece of string, ribbon, or yarn to represent their length at birth. In the second, they will have created a timeline illustrating and describing one important event that has taken place each year of their lives so far. **Students will measure and compare their lengths as babies:** Introduce the session by talking a bit about how much they've changed since they were born. ● What were you like when you were a newborn? ● How did you change over time? ● How are you different now? Explain that, in a minute, students are going to meet in groups of three to share and compare the lengths of string, yarn, or ribbon that represent how long they were when they were born, and to measure how tall they are now. Model the tasks they will complete in their groups, reviewing the ways in which they can be precise in their measuring. For each step, ask students how to be sure they are being accurate. ● First they will order their three baby length strings from shortest to longest. ● Next, they will measure each of the baby length strings with Unifix cubes and record the lengths in the Baby Length column on the record sheet. (You need only measure and record one student's baby length string to demonstrate.)



- Then they will help each other cut a length of string to match how tall they are now. (Model with a student lying on the floor, write the name on masking tape, and attach it to the string.)
- Then they will measure each of the lengths with Unifix cubes and record the lengths in the Height Now column on the record sheet.
- Lastly, they will answer the questions at the bottom of the record sheet.

Baby Lengths Record Sheet

When We Were Babies

1 Compare your baby length string with two friends. Who was longer? Who was shorter? Line your strings up from shortest to longest to find out.

2 Now measure each string with Unifix cubes. Write the number of cubes in the Baby Lengths column next to each name.

Look At Us Now!

3 Help each other measure how tall you are now with a new piece of string.

- Lie down on the floor.
- Have your friends stretch the string out from head to foot and cut it off.
- Write your name on a piece of masking tape and attach it to your string.

4 Now measure each string with Unifix cubes. Write the number of cubes in the Height Now column next to each name.

How we've grown!		
Name	**Baby Length**	**Height Now**
	cubes	cubes
	cubes	cubes
	cubes	cubes

Students will compare measurements to figure out how much they have grown since they were born:
Ask the students to find the Baby Lengths Record Sheet they completed last session. Have them find and circle their own baby length and their current height on the sheet. Explain that students are going to meet in their groups of three from the previous session and figure out how much each of them has grown between the day they were born and now. Display a copy of the How We Have Grown page, and ask students to find the corresponding page in their Student Books. Explain that they need to figure out how many cubes they have grown from the time they were born until now. Let them know that they can use pictures, numbers, or words to solve the problem and show their work.

How We Have Grown

1 When I was born I was _______ cubes long.

2 Now I am _______ cubes long.

3 Use pictures, numbers, or words to figure out how many cubes you have grown from the time you were born to now. Write the answer on the line at the bottom of the page.

Students share and analyze each other's timelines:
Introduce the session by asking students what they learned when making their timelines at home.

- Were there any surprises?
- Did they remember some of the events?
- What made the events special?

Explain that students are going to go on a gallery walk in pairs to view all of their classmates' timelines.
After several minutes, have the group return to the discussion area to discuss what they've seen.

- Were there some events that they saw over and over?
- Were there events that were unique?
- Why are some events common to so many students?

Continue the discussion by asking how long some of the events took.

- Learning to walk?
- Moving to a new house?
- Losing a tooth?

Now ask the question: How do you think you might change over the summer? How about over the next year?
Brainstorm ideas for how a person their age could change in just one second, one minute, one week, one month, or one year. Record

My Timeline

Note to Families
Now that your child has been thinking about how they've grown and changed over the years, it's time to make a timeline of their life. You can help them think of an important event from each year of their life, and to find photos to represent each event (or have them draw pictures if you don't have the photos).

Materials

- My Timeline Home Connection page
- 7 photos, 1 for each year of your life [OR] drawings or magazine pictures
- tape or glue, depending on whether you want to remove the pictures later or not

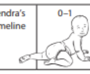
Instructions

A lot has happened to you since you were born!

1 Think about the important things that have happened. Can you think of one thing from each year? You might want to include your birth, when you started school, and other important events in your life (like moving to a new town, going on a great vacation, learning to ride a bike, starting to walk, having a new baby or pet in your family, etc.).

2 Have an adult help you collect a photo for each event, or help you draw a picture or cut one out of a magazine.

3 Put the first picture in the first empty space on your timeline. Use tape or glue. Leave room under the picture for a caption.

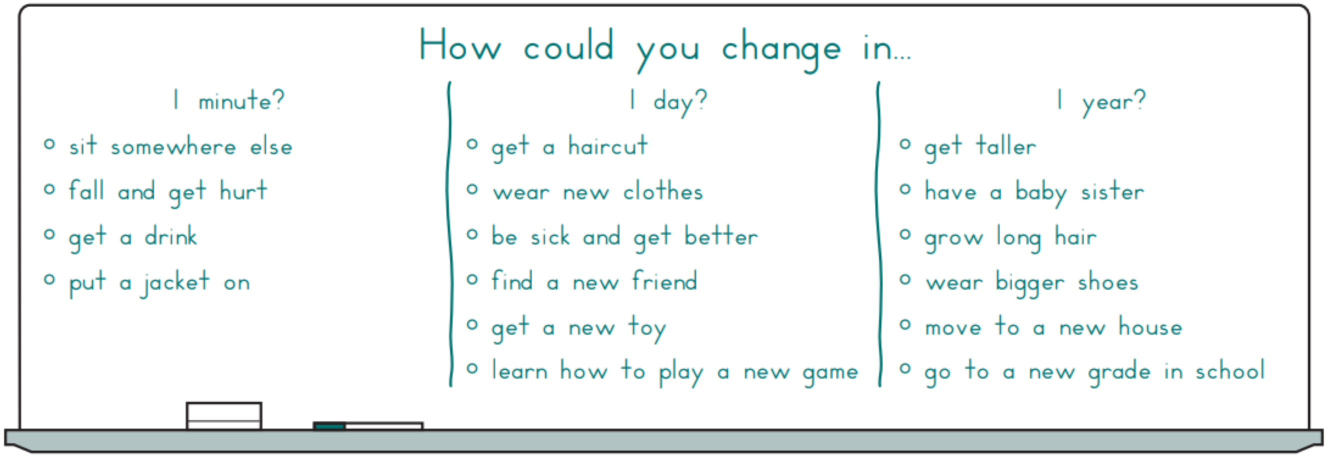
Kendra's Timeline	0–1	2	3	4	5	6	7
							

4 Write a caption under the picture. For example, if the picture is of you when you were born, you could write, "I was born July 10, 20__."

5 Continue placing or drawing a picture in each space, and writing a caption underneath.

6 Bring your timeline back to school.

ideas for one minute, one day, and one year on the board.



Interdisciplinary / Real World / Global Connections

- Reading a digital or analog clock is necessary all throughout a typical day.
- Measuring time in hours, minutes and seconds is used in the workplace, kitchen, etc.
- Measuring length and height with tools such as rulers, yardsticks or measuring tapes is a skill frequently used at work and at home.

Westbrook High School Learning Expectations

The Westbrook High School student will meet expectations by…

☐ Reading a wide range of texts effectively

☐ Writing effectively for a variety of purposes

☐ Presenting ideas accurately with the support of engaging media

☒ Thinking critically to solve problems and reach well reasoned judgments

☒ Working responsibly and collaboratively

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

Support:

- When applicable give students smaller numbers/smaller amount of objects to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- When possible, give students manipulatives (cubes, bears) and tools (math rack/number path) for concrete/pictorial representation
- See "Game Variations" in workplace guides
- See "Assessment and Differentiation" in workplace teacher masters

English Language Learners (ELL):

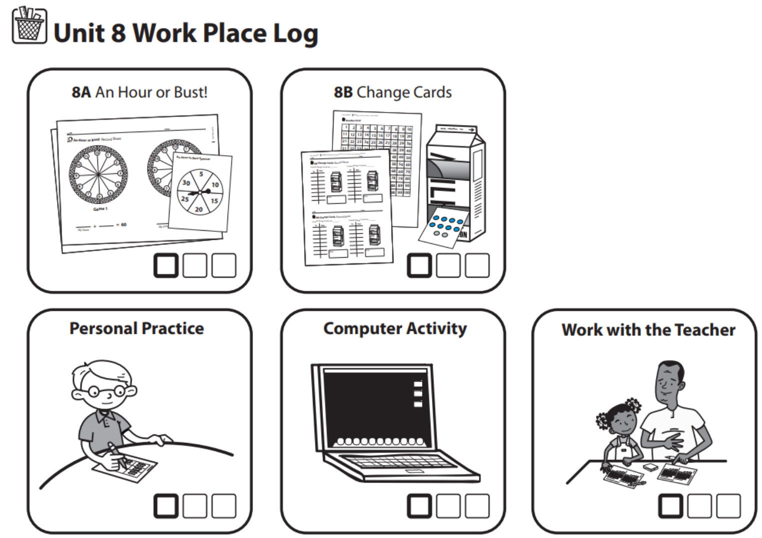
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play
- Use workplace sentence frames to support student discourse using math vocabulary
- Make visual word resource cards available to students who need extra language support
- Give students visual word cards for non-academic vocabulary as necessary

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 8 Time & Change Checkpoint

Time & Change Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name																	
1 Identifies the approximate duration of an event. *Choice 2, 1 minute*	Supports K.MD	**1 pt.**																		
2 Tells time to the hour on an analog clock; knows that 5:00 is 1 hour later than 4:00. *Choice 3, the clock that reads 5:00*	1.MD.3	**1 pt.**																		
3a Counts by 5s on a clock face to determine how many minutes the students got on each spin. Adds the spins to get the students' total. *25 + 15 + 15 = 55*	1.NBT.4	**4 pts.** • 1 pt. for each quantity of minutes correctly counted and recorded (25, 15, and 15) • 1 pt. for the correct total (55)																		
3b Compares two 2-digit numbers to determine who won the game and by how much. *The students won by 5 minutes*	1.NBT.3	**1 pt.**																		
4a Adds 10 to various 2-digit numbers. *30, 35, 40, 50*	1.NBT.4 1.NBT.5	**4 pts.** • 1 pt. for each correct answer																		
4b Subtracts 10 from various 2-digit multiples of 10. *40, 50, 70, 80*	1.NBT.5 1.NBT.6	**4 pts.** • 1 pt. for each correct answer																		
TOTAL SCORE/LEVEL OF PROFICIENCY*		**15 pts.**																		

- Unit 8 Post-Assessment

Unit 8 Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name									
1 Identifies the approximate duration of an event. *Choice 2, 1 minute*	Supports K.MD	**1 pt.**										
2 Tells time to the hour on an analog clock; knows that 5:00 is 1 hour later than 4:00. *Choice 3, the clock that reads 5:00*	1.MD.3	**1 pt.**										
3a Counts by 5s on a clock face to determine how many minutes the students got on each spin. Adds the spins to get the students' total. *25 + 15 + 15 = 55*	1.NBT.4	**4 pts.** • 1 pt. for each quantity of minutes correctly counted and recorded (25, 15, and 15) • 1 pt. for the correct total (55)										
3b Compares two 2-digit numbers to determine who won the game and by how much. *The students won by 5 minutes*	1.NBT.3	**1 pt.**										
4a Adds 10 to various 2-digit numbers. *30, 35, 40, 50*	1.NBT.4 1.NBT.5	**4 pts.**										
4b Subtracts 10 from various 2-digit multiples of 10. *40, 50, 70, 80*	1.NBT.5 1.NBT.6	**4 pts.**										
5a–c Uses a train of Unifix cubes to measure three different glider flights *37, 45, 52*	1.NBT.1 1.MD.2	**3 pts.**										
6a Determines how many tally marks there are in each column of a tally chart	1.MD.4	**3 pts.**										

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 1: Addition and Subtraction Facts
Pacing	5 Weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

Priority/Focus Standards:
2.OA.1 Solve one-step addition problems with sums to 100 involving situations of adding to and putting together, with unknowns in all positions.
2.OA.1 Solve one-step subtraction problems with minuends to 100 involving situations of taking from, taking apart, and comparing,

with unknowns in all positions.
2.OA.2 Fluently add and subtract with sums and minuends to 20 using mental strategies.
2.OA.3 Determine whether a group of objects (up to 20) has an odd or even number of members.

Supporting Standards:
2.MD.10 Make a picture graph to represent a data set with up to 4 categories.
2.MD.10 Make a bar graph to represent a data set with up to 4 categories.
2.MD.10 Solve simply put-together (addition), take-apart (subtraction), and comparison problems using data shown on a bar graph with up to 4 categories.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Classify objects into categories.	1. Objects can be classified by their characteristics.
2. Organize data with two categories.	2. Data can be represented on different kinds of graphs.
3. Represent data with two categories.	3. Graphs are visual representations of data.
4. Interpret data with two categories.	4. Graphs make interpreting data easier.
5. Make a picture graph and bar graph to represent data with at least two categories.	5. Different types of graphs represent data in different ways.
6. Solve simply put-together, take-apart and comparison problems using data shown in a graph with at least two categories.	6. Numbers can be taken apart by subtracting.

7. Solve subtraction problems by finding an unknown addend.	7. Addition and subtraction are inverse operations.
8. Use strategies to add sums to 20.	8. Numbers can be put together by adding.
9. Compare pairs of two-digit numbers.	9. Numbers' place value can be used to determine its magnitude in comparison to another number.
10. Solve one-step addition and subtraction story problems with sums and minuends to 100.	10. Addition and subtraction situations follow a predictable set of structures.
11. Determine whether a group of objects (up to 20) has an odd or even number of members.	11. A number is even if it can be divided by two without a remainder, otherwise the number is odd.
12. Find the total number of objects in an array (up to 5x5) using addition.	12. You can represent the total number of objects in an array with a repeated addition equation.
13. Fluently ADD with sums to 20.	14. Whole numbers can be represented by points on a number line.
15. Represent whole numbers on a number line.	16. Addition and subtraction can be modeled on a number line.
17. Represent whole number sums and differences within 100 on a number line.	17. Number lines can be partitioned and subdivided in different ways depending on the numbers in a particular problem.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What does it mean to add or subtract? 2. How are these two operations related?	1. Addition and subtraction are used to solve many different kinds of problems. 2. Part-part-whole relationships can be expressed by using

	number sentences like a + b = c or c – b = a, where a and b are the parts and c is the whole. a. Subtraction has an inverse relationship with addition. b. The commutative and associative properties for addition of whole numbers allow computations to be performed flexibly.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

Standard 1.5.b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Books / Media:

- **Informational Books:**
  - Data and Graphing Books
  - Arctic Fives Arrive
- **Media:**
  - Skip Counting By 5s Song

Online Resources / Websites:

- Math Learning Center: Pattern Shapes
- Create a Graph: Teacher Tool
- Data Grapher: Teacher Tool
- Math Learning Center: Number Rack
- Game: How Many Under the Shell
- Game: Jet Ski Addition

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Add: to combine; to put together two or more quantities.
Array: an arrangement consisting of equal rows and equal columns.
Compare: to examine to note similarities and differences; to determine whether numbers are greater than, less than or equal.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Greater Than: a symbol used to indicate that the number on the left is greater than the number on the right.
Hundreds: the numbers 100 to 999; also refers to the hundreds place.
Length: how long something is.
Less Than: a symbol used to indicate that the number on the left is less than the number on the right.
Number Line: a diagram in which numbers are represented as points on a number line.
Ones: the numbers 0 through 9; also refers to the ones place.
Pattern: a collection of numbers, shapes or objects that forms a consistent or characteristic arrangement.
Subtract: to take one quantity away from another or find the difference between two numbers.
Tens: the numbers 10-99; also refers to the tens place.

Learning Plan

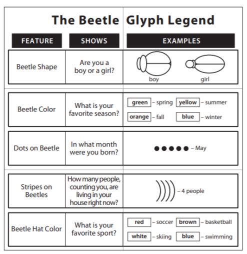
Overview and Key Learning Events and Instruction Per Week

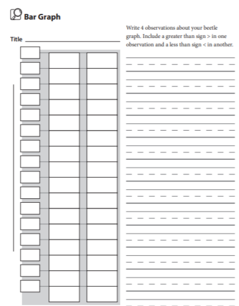
Unit 1 works toward the establishment of classroom norms around mathematical inquiry and discourse. The mathematical focus rests primarily on the development of number sense, operations, and fact fluency to 20. Important mathematical models including the number rack, bead strings, and the number line are introduced during the unit, and students are expected to become proficient at using strategies that emerge from these models. The contexts for learning mathematics are single and double decker buses and plates of different shapes and colors at a dinner party.

Learning Tasks Per Week (Including Instructional Strategies)

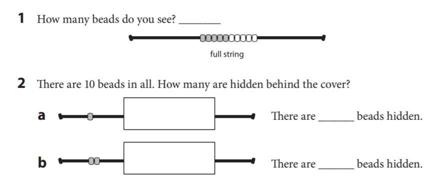
Week 1: The unit opens with a session in which students create glyphs to represent personal information: gender, favorite season, birth month, number of people with whom they live, and favorite sport. In subsequent sessions, the teacher and students sort and graph the glyphs in a variety of ways, learning more about their new classroom community in the process. The last session in Module 1 includes a unit pre-assessment. Sessions 2–5 also feature Work Places designed to familiarize the class with the basic math materials and classroom routines that will be in use all year.

Create individual beetle glyphs to **sort, analyze, interpret** and **represent** data from class glyphs.

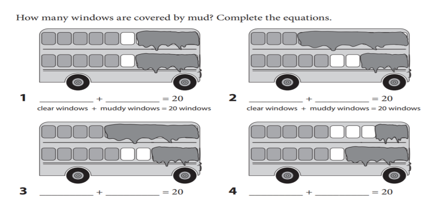




Week 2: Number Facts with the Number Rack The sessions in this module are designed to reinforce number facts to 10 and to introduce fact strategies to 20. The number rack is introduced to model number relationships, combinations, and the addition and subtraction facts.



Reinforce number facts to ten.



Explore facts to twenty. Use the number rack to examine number relationships, combinations, and addition and subtraction facts.

Week 3: Introducing Addition & Subtraction Strategies During the first three sessions in this module, students continue to use the number rack to develop fluency with number facts to 20. New strategies and number relationships introduced include Doubles and Halves, Doubles Plus or Minus One, and even and odd numbers. Sessions 4 and 5 highlight subtraction as a process of finding the difference between two quantities.

Develop strategies for addition and subtraction facts including Doubles and Halves, Doubles Plus or Minus One, and even and odd numbers.

Model strategies and number relationships using the number rack.

Unit 1 Module 3 | Session 2 *1 copy for display*

Even & Odd Chart

Start Number	Can we split it into two equal groups? YES	NO	This is an EVEN number	This is an ODD number
1				
2				

Have students get out their number racks, and work with their input to fill in the Even & Odd Chart.

- Ask students to show each quantity as the sum of two equal sets of beads if possible.
- Place a check mark in the appropriate box on the chart to show whether or not it is possible to split the number into 2 equal groups.
- Next, ask students whether or not the number is even or odd, and place a check mark in the appropriate column.
- Continue in this fashion until the chart is completed.

Tip Use a pencil to separate the doubles pair from the solo bead to help students see that there is always 1 bead left without a partner if a number is odd.

Quickly have students review the concept of doubling by asking them to hold up 3 fingers on one hand and then double the quantity using the fingers on their other hand. (They will hold up 6 fingers in all.)

Next, review the concept of halving by asking students to show 4, 10, and then 8 fingers, by holding up the same number of fingers on each hand.

> ***Teacher*** *Now hold up the same number of fingers on each hand so that you're showing 4 fingers in all.*

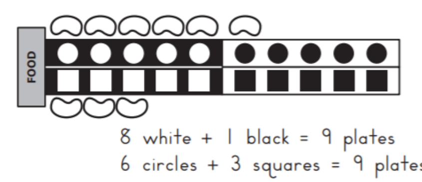
Apply understanding of these relationships to solve story problems about seating guests at a dinner party in different ways to emphasize number combinations to 20.

Clear the beans off the teacher master, and ask students to pair-share some of the ways the seats could be arranged if 9 people were coming to dinner.

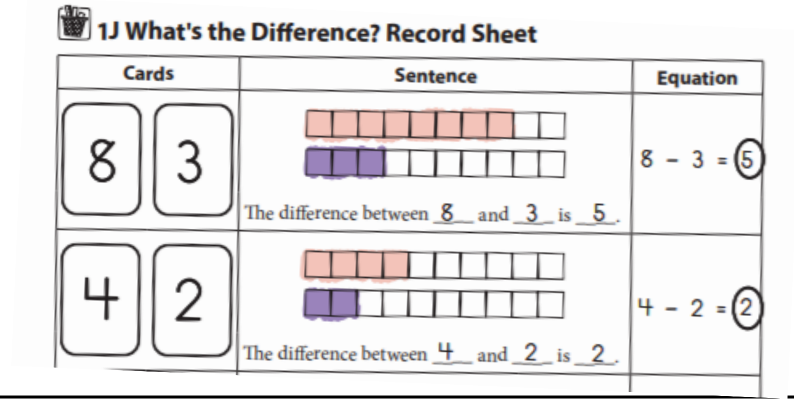
- Call on volunteers to share several different possibilities.
- For each arrangement suggested, place the beans appropriately. Then work with students to write an equation to represent the number of black and white plates in use, and a second equation to represent the number of circle and square plates in use.

Unit 1 Module 3 | Session 3 *1 copy for display*

The Dinner Party



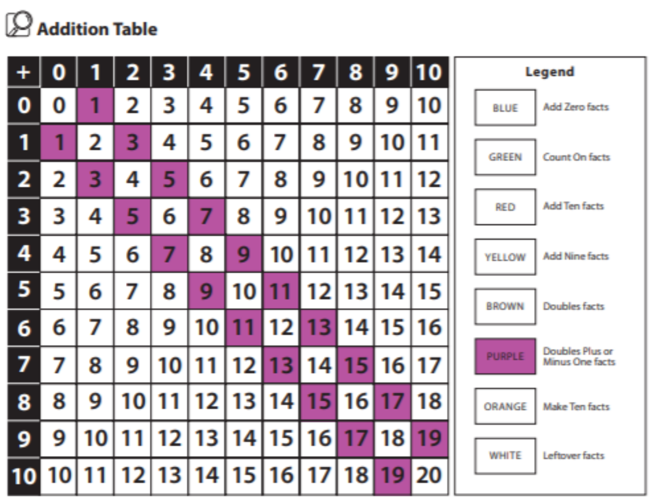
Compare two quantities by using subtraction.


1J What's the Difference? Record Sheet

Cards	Sentence	Equation
8 3	The difference between 8 and 3 is 5.	8 - 3 = 5
4 2	The difference between 4 and 2 is 2.	4 - 2 = 2

Week 4: Fluency with Addition Facts to Twenty The last module in Unit 1 focuses tightly on fluency with number facts to 20 and asks students to apply these facts in story problem contexts. The number rack, bead strings, and the number line are used to support the development of strategies helpful for recalling the number facts. The final session features a unit post-assessment.

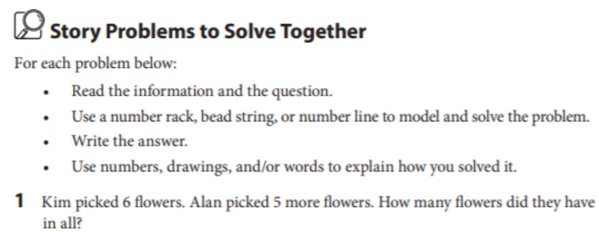
Develop fluency with addition facts to 20 using the number rack, bead string, and the number line models while focusing on strategies including Add Zero, Count On, Add Tens, Add Nines, Make Ten, Doubles, Doubles Plus or Minus One and the Leftover Facts. Use addition facts in story problem contexts.


Addition Table

+	0	1	2	3	4	5	6	7	8	9	10
0	0	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10	11
2	2	3	4	5	6	7	8	9	10	11	12
3	3	4	5	6	7	8	9	10	11	12	13
4	4	5	6	7	8	9	10	11	12	13	14
5	5	6	7	8	9	10	11	12	13	14	15
6	6	7	8	9	10	11	12	13	14	15	16
7	7	8	9	10	11	12	13	14	15	16	17
8	8	9	10	11	12	13	14	15	16	17	18
9	9	10	11	12	13	14	15	16	17	18	19
10	10	11	12	13	14	15	16	17	18	19	20

Legend

BLUE	Add Zero facts
GREEN	Count On facts
RED	Add Ten facts
YELLOW	Add Nine facts
BROWN	Doubles facts
PURPLE	Doubles Plus or Minus One facts
ORANGE	Make Ten facts
WHITE	Leftover facts


Story Problems to Solve Together

For each problem below:

- Read the information and the question.
- Use a number rack, bead string, or number line to model and solve the problem.
- Write the answer.
- Use numbers, drawings, and/or words to explain how you solved it.

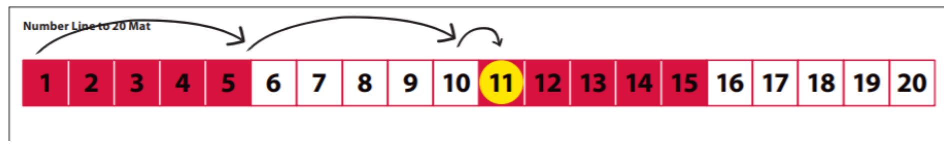
1 Kim picked 6 flowers. Alan picked 5 more flowers. How many flowers did they have in all?

__Teacher__ OK! Did anyone use their bead string to solve this problem? Bring your string up and show us what you did.

__Student B__ I moved over 6 beads, and then I counted 5 more, see? Six, 7, 8, 9, 10, 11.

__Teacher__ All right, so she used the bead string and counted on to get 11 flowers in all. Did anyone use the number line to solve this problem? Bring your number line up here to the document camera and show us what you did.

__Student C__ Five and 6 is kind of like 5 and 5, so I hopped the marker up to the 5, and then hopped another 5 and 1 more. I landed on 11.



Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)
- Students create beetle glyphs to make connections between their personal data and data and graphing in the real world.
- Students use the windows of a bus to make connections to the math rack. This encourages them to look for patterns and structure in other real-world experiences.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☒ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play.
- See "Game Variations" in work place guides.
- See "Assessment and Differentiation" in work place teacher masters.

Support:
- When applicable, give students smaller numbers to practice the strategies.
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall.
- See "Game Variations" in work place guides.
- See "Assessment and Differentiation" in work place teacher masters.

MLL (Multilingual Learners)**:**
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play in a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work
- Number Strings

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Number Combinations to Ten Checkpoint
- Unit 1 Post-Assessment

Number Combinations to Ten Checkpoint Scoring Guide

Item and Correct Answer	CCSS	Points Possible	Student Name											
1 Reports that there are 10 beads on the string.	K.CC.5	**1 pt.**												
2a–i Identifies how many beads out of 10 are hidden. *9, 8, 5, 2, 3, 4, 2, 2, 3*	1.OA.4 2.OA.2	**9 pts.** 1 pt. for each correct answer												
3a–h Solves addition combinations to 12. *10, 11, 9, 11, 12, 10, 12, 11*	2.OA.2	**8 pts.** 1 pt. for each correct answer												
4a-h Solves subtractions combinations to 11. *3, 7, 4, 2, 8, 9, 5, 4*	2.OA.2	**8 pts.** 1 pt. for each correct answer												
TOTAL SCORE/LEVEL OF PROFICIENCY*		**26 pts.**												

* **Meeting Standard:** 18–26 points (75–100% correct) **Approaching Standard:** 13–17 points (50–74% correct) **Strategic:** 7–12 points (25–49% correct) **Intensive:** 6 points or fewer

Unit 1 Post-Assessment Scoring Guide

Item and Correct Answer	CCSS	Points Possible	Student Name				
1a–d Identifies how many more beads are needed on the number rack to total 20. *5, 5, 13, 5*	1.OA.4 2.OA.2	**4 pts.** • 1 pt. for each correct answer					
2a-e Identifies how many beads are covered on a 2-bar, 20-bead number rack. *10, 6, 14, 5, 8*	1.OA.4 2.OA.2	**5 pts.** • 1 pt. for each correct answer					
3a-c Identifies which number rack of two has more beads, and tells how many more beads it has than the other rack. *Rack 1, 1 more; Rack 1, 1 more; Rack 2, 2 more*	1.NBT.3 2.OA.2	**3 pts.** (1 per problem) • half point for identifying the rack that has more • half point for telling how many more					
4 Circles the number racks that are showing an odd number of beads. *Racks a, c, d, e, and h all have an odd number of beads.*	2.OA.3	**5 pts.** • 1 pt. for each correct answer					
5a Solves an addition story problem that involves adding on 4 more to 8 and shows work. *12 flowers in all* **or** *20 flowers in all.* *Students might interpret "Alex picked 4 more flowers" as Alex picking 4 more flowers* than Misty*—12 flowers.* *Students who interpret the problem this way add 8 + 12 = 20.* ***Accept 20 if the student's work supports it.***	2.OA.1	**2 pts.** • 1 pt. for correct answer (12 *or* 20) • 1 pt. for showing work that could lead to the correct answer					
5b Solves a subtraction story problem that involves comparing 9 and 13, and shows work. *Peter ate 4 cookies.*	2.OA.1	**2 pts.** • 1 pt. for correct answer • 1 pt. for showing work that could lead to the correct answer					
6 Identifies each combination by fact type and solves the combination correctly. *13–red; 14–brown; 17–purple; 18–red; 11–purple; 7–purple; 18–brown; 10–orange; 16–brown; 10–orange; 17–red; 15–purple; 15–red; 12–brown*	1.OA.6	**28 pts.** (2 per problem) • 1 pt. for circling the combination in the correct color • 1 pt. for correct answer					
TOTAL SCORE/LEVEL OF PROFICIENCY*		**49 pts**					

* **Meeting Standard:** 37–49 points (75–100% correct) **Approaching Standard:** 25–36 points (50–74% correct) **Strategic:** 13–24 points (2

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 2: Place Value and Measurement
Pacing	5 Weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
2.OA.1 Solve one-step addition problems with sums to 100 involving situations of adding to and putting together, with unknowns in all positions.
2.OA.2 Fluently add and subtract with sums and minuends to 20 using mental strategies.

2.NBT.1 Demonstrate an understanding that the digits in a 3-digit number represents the amounts of hundreds, tens, and ones.
2.NBT.2 Skip-count by 5s and 10s within 1,000.
2.NBT.3 Read and write numbers to 1,000 represented with numerals, number names, and expanded form.
2.NBT.4 Compare pairs of 3-digit numbers, using >, =, and < symbols to record the results of comparisons.
2.NBT.5 Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to add fluently with sums to 100.
2.NBT.6 Add three or four 2-digit numbers.
2.MD.4 Determine exactly how much longer one object is that another.
2.MD.6 Represent whole numbers as lengths, and whole-number sums within 100 on a number line.

Supporting Standards:

2.OA Model and describe multiplication situations in which sets are joined.
2.OA Identify, describe, and extend number patterns.
2.OA Extends a growing pattern.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Read numbers to 1,000 using numerals, number names and expanded form.	1. 3-digit numbers are made of hundreds, tens, and ones.
2. Write numbers to 1,000 using numerals, number names and expanded form.	2. The value of numbers is determined by the position of its digits.
3. Compare pairs of 3-digit numbers.	3. The digit's place in a number determines its value and magnitude.

4. Use >, =, < symbols to record comparisons of two 3-digit numbers.	4. The symbols >, < and = are used to explain a number's magnitude in comparison to another.
5. Fluently add within 100 using strategies based on place value.	5. Two 2-digit numbers can be added by combining ones with ones and tens with tens, then regrouping if necessary. 100 can be thought of as a bundle/group of 10 tens (called a hundred).
6. MEASURE the length of an object by laying multiple copies of a shorter unit end to end.	6. We measure length using a tool end to end without gaps or overlaps.
7. Represent the whole number sums up to 100 on a number line.	7. Number lines can be partitioned and subdivided in different ways depending on the numbers in a particular problem.
8. Solve one-step addition and subtraction story problems with sums and minuends to 100, in situations of adding to, taking from, and comparing, with unknowns in different positions.	8. Basic addition facts within 20.
9. Skip-count by 10s within 1,000.	9. The rote counting sequence patterns through 100 are repeated as numbers become larger.
10. Skip-count by 5s within 1,000.	10. The scale on a number line can vary between number lines and within the same number line allowing for flexibility in extending counting strategies to counting by ones, twos, fives, tens and hundreds.
11. Find the total number of objects in an array using addition.	11. You can represent the total number of objects in an array with a repeated addition equation.
12. Represent whole-number sums and differences within 20 on a number line.	12. Addition and subtraction are inverse operations.

13. Express the length of an object as a whole number of units.	13. Things can be measured using standard or non-standard units if the units are the same size.
14. Find the perimeter of a polygon, given the length of its sides.	14. Perimeter is the length around a polygon.
15. Measure the length of an object in non-standard units.	15. Things can be measured using standard or non-standard units if the units are the same size.
16. Determine exactly how much longer one object is than another.	16. Subtraction can be used to find the difference between two lengths.
17. Mentally add 10 to any 3-digit number between 100 and 1,000.	17. When adding 10 to any number the digit in the tens place increases by one.
18. Add three 2-digit numbers using strategies based on place value and properties of operations.	18. Properties of addition and subtraction. Numbers can be grouped in different ways; 123 is 1 hundred, 2 tens and 3 ones or 12 tens and 3 ones.
19. Write an equation to represent the total number of objects in an array with up to 5 rows and 5 columns as the sum of equal addends.	19. You can represent the total number of objects in an array with a repeated addition equation.
20. Identify, describe, and extend number patterns and growing patterns.	20. Our number system has predictable, repeating patterns based on its structure.
21. Determine whether a group has an odd or even number of members.	21. A number is even if it can be divided by two without a remainder, otherwise, the number is odd.
22. Model and describe multiplication situations in which sets of equal size are joined.	22. When you add a number to itself, you are doing the number.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why should we understand place value? 2. How does the value of a digit change when its position in a number changes? 3. How can we use place value to help us add and subtract larger numbers?	1. The value of a digit depends on its place in a number. 2. Our number system is made up of only 10 unique digits (0-9). 3. We can use knowledge of place value to combine numbers and take them apart; grouping/taking tens to/from tens and ones to/from ones.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.b**: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Books / Media:
• **Informational Books:**
  ○ Great Estimations
  ○ Is a Blue Whale the Biggest Thing There Is?
 	
Online Resources / Websites:
• Math Learning Center: Number Pieces App
• Math Learning Center: Number Line App
• Arrow Cards
• Jack and The Beanstalk
• Game: Shark Numbers
• Game: Count on Catapult

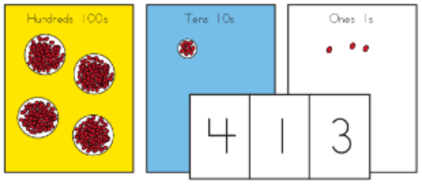
- Game: Odd and Even
- Song: Counting by 2s
- Song: Even Numbers
- Book: Even Steven and Odd Todd
- Website: Interactive Hundreds Chart (count by 2s, 5s, 10s)
- Song: Odd Song
- Activity: Odd or Even numbers

Vocabulary/Terminology

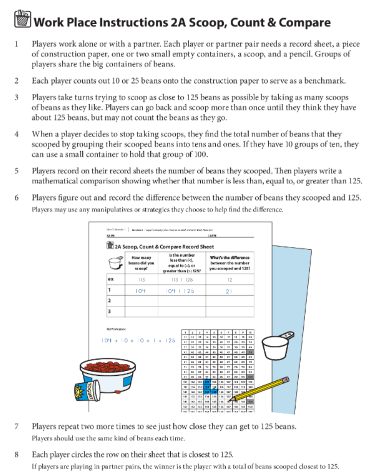
Vocabulary/Terminology with Definitions:

Add: to combine; to put together two or more quantities.
Compare: to examine to note similarities and differences; to determine whether numbers are greater than, less than or equal.
Equation: a mathematical statement asserting that two quantities have the same value.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough.
Count: measurement or calculation.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Fewer than: smaller quantity or amount.
Greater than: a symbol used to indicate that the number on the left is greater than the number on the right.
Hundreds: the numbers 100 to 999; also refers to the hundreds place.
Length: how long something is.
less than: a symbol used to indicate that the number on the left is less than the number on the right.
Number line: a diagram in which numbers are represented as points on a number line.
Ones: the numbers 0 through 9; also refers to the ones place.
Pattern: a collection of numbers, shapes or objects that forms a consistent or characteristic arrangement.
Perimeter: the distance in linear units around a two-dimensional (flat) figure.
Regroup: to rearrange numbers by place value; units into groups of tens and groups of tens into hundreds.
Skip jump: counting forward by numbers other than 1. To skip count, we keep adding the same number each time to the previous number.
Subtract: to take one quantity away from another or find the difference between two numbers.

Tens: the numbers 10-99; also refers to the tens place.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Unit 2 moves students through counting and grouping discrete objects by place value, to measure length with trains of Unifix cubes, to creating their own measurement tapes marked in intervals of 5 and 10 cubes, and finally to adding double-digit numbers in an open number line. The context anchoring the mathematics is a new story of Jack and the Beanstalk. **Learning Tasks Per Week (Including Instructional Strategies)**
Week 1: Counting & Modeling Two- & Three-Digit Numbers Module 1 opens with a reading of Jack and the Beanstalk. Then students estimate how many lima beans there are in the teacher's sack, and work together to organize and count the beans by hundreds, tens, and ones. Subsequent activities in this module ask students to model 2- and 3-digit numbers with manipulatives and arrays, decompose numbers by place value, add numbers by regrouping sets of tens and ones, identify numbers based on their component parts, and write numbers in standard and expanded notation.
Day 1: Counting Beans This session begins with a reading of Jack and the Beanstalk, a folktale that will inform much of the work in Unit 2. The teacher then introduces a counting project in which students work together to count a large collection of beans into groups of hundreds, tens, and ones. 
Day 2: Unit 2 Pre-Assessment The teacher introduces a new Workplace designed to provide students with further opportunities to estimate, count, and compare sets of beans. Then students take the unit pre-assessment and go to Work Places as they finish. Introducing WorkPlace 2A Scoop, Count & Compare Players get three chances to scoop as close to 125 beans as possible out of a container. First, players create a benchmark by counting out 10 or 25 beans onto a piece of construction paper. Then they scoop, count, and record the number of beans they scooped. Next, players write a mathematical expression to show whether the number of beans they scooped was less than, equal to, or greater than 125, and find the difference between that number and 125. The player

who scooped closest to 125 beans wins.



Work Place Instructions 2A Scoop, Count & Compare

1 Players work alone or with a partner. Each player or partner pair needs a record sheet, a piece of construction paper, one or two small empty containers, a scoop, and a pencil. Groups of players share the big containers of beans.

2 Each player counts out 10 or 25 beans onto the construction paper to serve as a benchmark.

3 Players take turns trying to scoop as close to 125 beans as possible by taking as many scoops of beans as they like. Players can go back and scoop more than once until they think they have about 125 beans, but may not count the beans as they go.

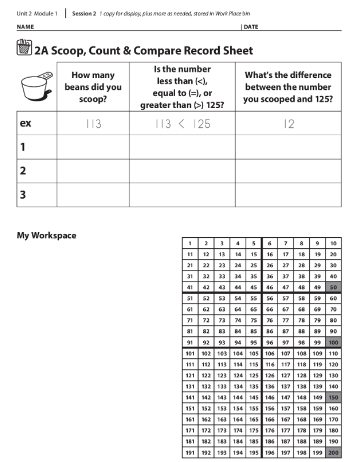
4 When a player decides to stop taking scoops, they find the total number of beans that they scooped by grouping their scooped beans into tens and ones. If they have 10 groups of ten, they can use a small container to hold that group of 100.

5 Players record on their record sheets the number of beans they scooped. Then players write a mathematical comparison showing whether that number is less than, equal to, or greater than 125.

6 Players figure out and record the difference between the number of beans they scooped and 125.
Players may use any manipulatives or strategies they choose to help find the difference.

7 Players repeat two more times to see just how close they can get to 125 beans.
Players should use the same kind of beans each time.

8 Each player circles the row on their sheet that is closest to 125.
If players are playing in partner pairs, the winner is the player with a total of beans scooped closest to 125.



Unit 2 Module 1 | Session 2 1 copy for display, plus more as needed, stored in Work Place bin

NAME | DATE

2A Scoop, Count & Compare Record Sheet

	How many beans did you scoop?	Is the number less than (<), equal to (=), or greater than (>) 125?	What's the difference between the number you scooped and 125?
ex	113	113 < 125	12
1			
2			
3			

My Workspace

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

Day 3: How Many More? How Many Fewer? Students continue to estimate, count, and compare quantities of beans to develop place value counting skills. As they finish the estimation and counting activities, they complete a related worksheet
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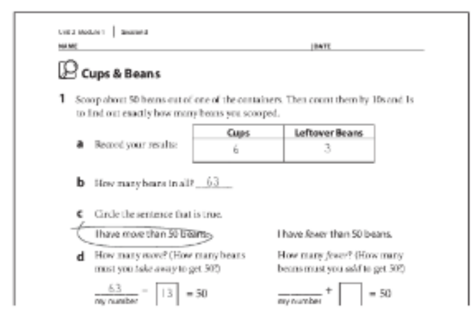


Unit 2 Module 1 | Session 3

NAME | DATE

Cups & Beans

1 Scoop about 50 beans out of one of the containers. Then count them by 10s and 1s to find out exactly how many beans you scooped.

a Record your results:

Cups	Leftover Beans
6	3

b How many beans in all? 63

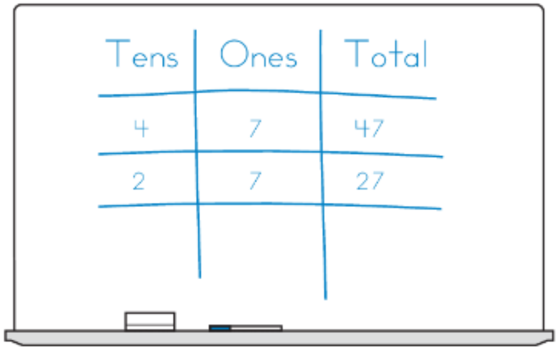
c Circle the sentence that is true.

I have more than 50 beans. I have fewer than 50 beans.

d How many more? (How many beans must you take away to get 50?) How many fewer? (How many beans must you add to get 50?)

63 (my number) − $\boxed{13}$ = 50 ____ (my number) + $\boxed{}$ = 50

Day 4: Show Me Tens & Ones In this session, students represent and combine numbers to 100 using Unifix cubes. The activity emphasizes grouping cubes in trains of 10, as well as using models to add and subtract within 100.



Day 5: Base Ten Riddles The teacher introduces a new Work Place involving simple subtraction facts, and then moves into an activity in which students use base ten area pieces to model 2- and 3-digit numbers. Students then complete a worksheet of related riddles. Introducing Work Place 2B The Subtraction Wheel Players take turns drawing Number Cards and using the numbers to complete a set of facts on a subtraction wheel. The first player to complete the set of facts on the subtraction wheel wins the round with a score of 0. The other player adds up the number of white spaces left on the wheel to get a score. Players play three rounds and add up their scores. The player with the lower score wins

Base Ten Riddles

Use your base ten pieces to solve these problems.

1. I have 2 tens and 5 ones. Who am I? _______
2. I have 30 ones and 1 hundred. Who am I? _______
3. If you gave me 2 more tens, I would be 80. Who am I? _______
4. I am 341. How many hundreds do I have? _______
5. I have 2 tens and 10 ones. Who am I? _______
6. I am 45. I have 25 ones. How many tens do I have? _______
7. I have 12 tens and 3 ones. Who am I? _______
8. I am 125. I have 12 tens. How many ones do I have? _______

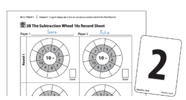
Work Place Instructions 2B The Subtraction Wheel

1 Two players decide together if they want to use the 10s, 11s, or 12s record sheet. They share the record sheet and a deck of Number Cards. Each player may use a number rack.

2 Players shuffle the Number Cards and place the deck face-down between them. Players take turns drawing one card from the top of the deck. The player with the higher number is Player 1; the other person is Player 2.

3 Players label the record sheet with their names.

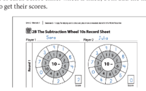
4 Player 1 draws one card and uses the number to fill in one of the blank spaces on the outside rim of his subtraction wheel. (If a player draws a 2, they use it to fill in the space outside the 8 because 10 – 8 = 2.)



5 Player 2 draws a card and uses the number to fill in one of the blank spaces on the outside rim of her wheel.

6 Players take turns drawing cards and filling in their wheels. If players draw a card they can't use, they lose their turn. The round ends when one player fills his wheel or when the cards run out.

7 Players figure out and record their score for each round. The player with the filled wheel has a score of 0. The other player finds his score by adding the number of white spaces left on his wheel. If players run out of cards before either wheel is filled, both add the number of white spaces left on their wheels to get their scores.



8 Players repeat for two more rounds. They shuffle the deck of Number Cards before starting each new round.

9 After 3 rounds, players add up all their scores. The player with the lower total wins the game.

(continued on next page)

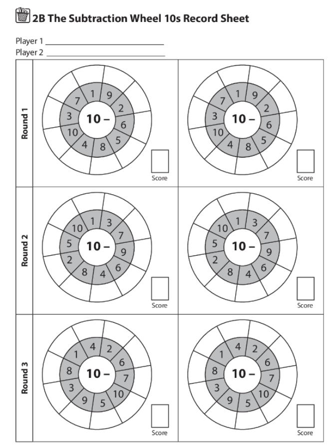
Work Place Instructions 2B The Subtraction Wheel

Game Variations

A Choose the 11s or 12s record sheet instead of 10s.

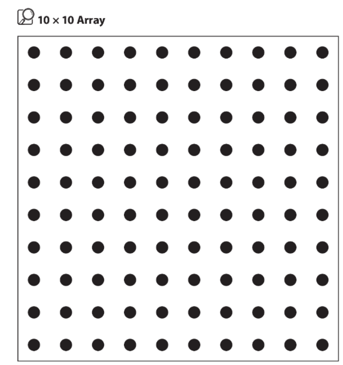
B If one player fills his wheel before running out of cards, let the other player continue to draw cards and fill in her wheel until she gets a card she can't use.

C Add the wild cards to the deck. If a player draws a wild card, he can name the number he wants it to represent and use that number to fill in one of the spaces on his wheel.

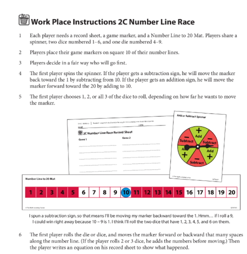


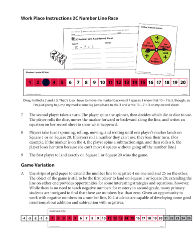
Week 2: Measuring Jack's Giant Beans with Tens During Module 2, the story of Jack and the Beanstalk takes its first twist as Jack discovers a beanstalk loaded with giant, multicolored beans. Jack finds a roll of adding machine tape in his pack and cuts lengths to match some of the beans. The teacher has cut lengths of adding machine tape to match the length of Jack's giant beans and invites students to measure the strips using Unifix cubes. This activity poses new challenges as each individual cube or group of 10 must be regarded as an interval of length rather than a discrete object. The work with cubes is extended into a second activity in which students measure the perimeters of garden beds Jack will use to grow more giant beans in his backyard.

Day 6: Rows & Dots The teacher uses two 10 × 10 arrays of dots to represent numbers in the range of 0–200, and students practice identifying the number of hundreds, tens, and ones, as well as the total number of dots displayed.

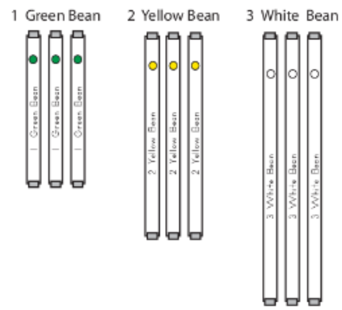


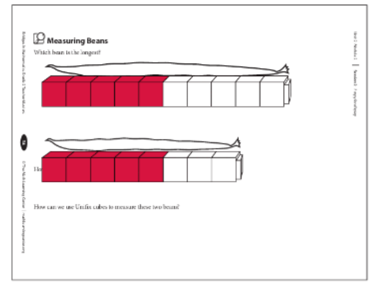
Day 7: Place Value Checkpoint
The teacher introduces a new Work Place, Number Line Race, a simple addition and subtraction game. After students have played the game in pairs, the teacher reconvenes the class to administer a place value checkpoint. Introducing Work Place 2C Number Line Race Players take turns using a spinner and dice to move forward or backward along a number line. Players start by placing a marker on the tenth square of a number line marked from 1 to 20. Players spin to find out if they will move forward along the line toward 20 by adding a number to 10, or backward along the line toward 1 by subtracting a number from 10. Then they roll one, two, or three dice to see how many squares they get to move ahead or back. Players record each move with an addition or a subtraction equation. The first player to land exactly on 20 or on 1 wins the game.



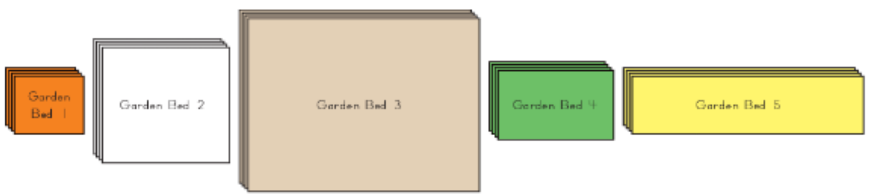


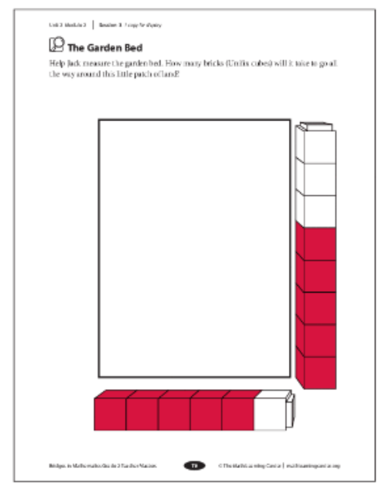
Day 8: Measuring Beans for Jack Students use Unifix cubes to measure lengths of adding machine tape cut to match Jack's giant beans. Toward the end of the session, the teacher reconvenes the class to discuss students' results and some of the strategies they used to measure the paper strips.





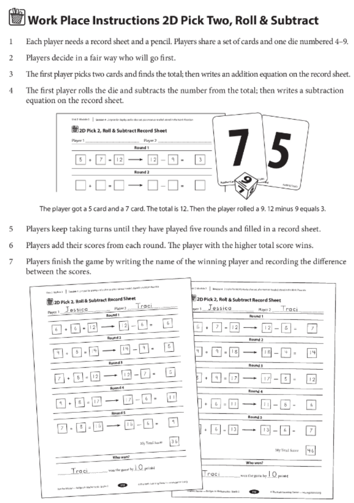
Day 9: Jack's Garden Beds Students measure the perimeter of small paper garden beds, again using Unifix cubes as the unit of measure. Results are posted on a chart and discussed as a whole group.





Day 10: Measuring Checkpoint Today.

Introduce a new Work Place game that provides practice with subtraction facts to 20. Students then take a short checkpoint assessment that looks at their current skills with measuring and comparing lengths. Introducing Work Place 2D Pick Two, Roll & Subtract Players take turns drawing two cards, finding a total for the numbers drawn, and then subtracting a number that is rolled on a die to get a score for the round. Players play five rounds and then add their scores and compare results. The player with the higher final score wins

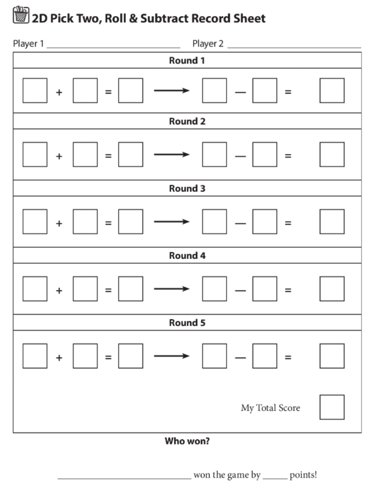


Work Place Instructions 2D Pick Two, Roll & Subtract

1 Each player needs a record sheet and a pencil. Players share a set of cards and one die numbered 4–9.
2 Players decide in a fair way who will go first.
3 The first player picks two cards and finds the total; then writes an addition equation on the record sheet.
4 The first player rolls the die and subtracts the number from the total; then writes a subtraction equation on the record sheet.

The player got a 5 card and a 7 card. The total is 12. Then the player rolled a 9. 12 minus 9 equals 3.

5 Players keep taking turns until they have played five rounds and filled in a record sheet.
6 Players add their scores from each round. The player with the higher total score wins.
7 Players finish the game by writing the name of the winning player and recording the difference between the scores.



2D Pick Two, Roll & Subtract Record Sheet

Player 1 ____________ Player 2 ____________

Round 1

Round 2

Round 3

Round 4

Round 5

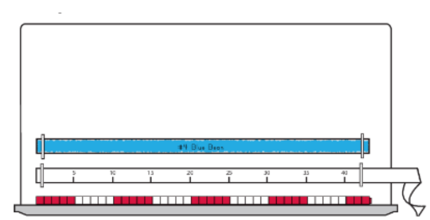
My Total Score

Who won?

____________ won the game by _____ points!

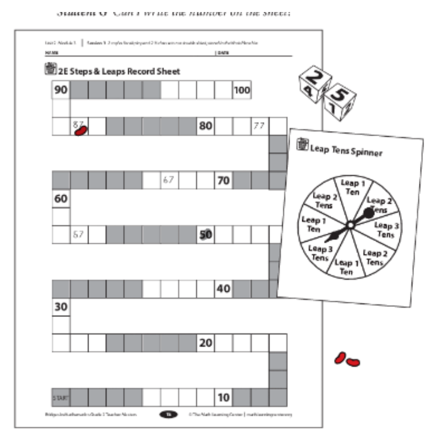
Week 3: Adding on the Open Number Line Students transition from measuring length with Unifix cubes to measuring length with paper strips marked in intervals of 5 and 10. Later in the module, these paper measuring strips, which are essentially marked number lines, give way to open number lines. The empty, or open, number line is introduced to model and solve addition problems that arise as Jack sells his giant beans at the farmers' market. This transition represents a shift in thinking as students move from adding discrete groups of 10s and 1s to making jumps of 10s and 1s along a line that has emerged from a measurement context.

Day 11: Introducing the Number Line Students work with the teacher to create a measuring tool that will help Jack measure his giant beans more efficiently than using cubes. This measuring tool, made of a long paper strip, might be easily recognized as a number line.



Day 12: Strips of Ten Today's session opens with a "count-around" activity in which students practice counting by 10s from numbers other than 10. After this warm-up activity, students make their own measuring strips and use them to measure different objects in the classroom.

Day 13: Introducing Work Place 2E Steps & Leaps The teacher introduces Work Place 2E Steps & Leaps and plays against the class. The game is played on a record sheet with steps to 100, organized into groups of 5 and 10. Once the teacher has introduced the game, students play in pairs and then go out to Work Places if time allows. Introducing Work Place 2E Steps & Leaps Players take turns rolling dice to move by 1s and spinning a spinner to leap forward by 10s. The game is played on a record sheet with steps to 100, organized into groups of 5 and 10. The first player to reach or move past 100 wins the game.



Day 14: Beans for Sale Jack's story continues during this session. Jack knows that he wants to sell his beans by their length 1¢ per cube of length, but he realizes that some customers may want to buy more than one bean. The black beans from one of Jack's beanstalks are all the same size—a convenient 10 cubes. The white beans from another stalk are all different sizes. Today students use a measuring strip/ number line model to help Jack add bean lengths

Measuring Beans for Market

black bean: 10 cubes long
white bean: 15 cubes long

How long are the two beans together? _______

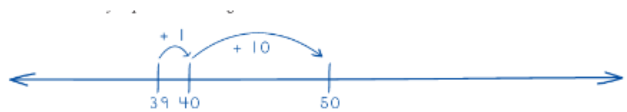
Price: _______

Bean Lengths & Prices

Jack charges for his beans by length: 1¢ per cube. Here are the lengths of his beans. How much will he charge for each of these beans?

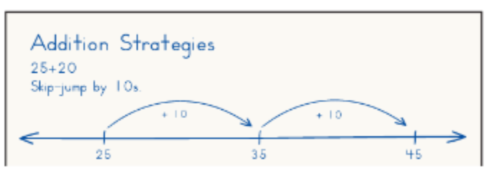
Type of Bean	Bean Length	Bean Price
Green Beans	10 cubes long	10 ¢ each
Red Beans	12 cubes long	______ ¢ each
Purple Beans	15 cubes long	______ ¢ each
White Beans	30 cubes long	______ ¢ each
Black Beans	45 cubes long	______ ¢ each
Rainbow Beans	60 cubes long	______ ¢ each

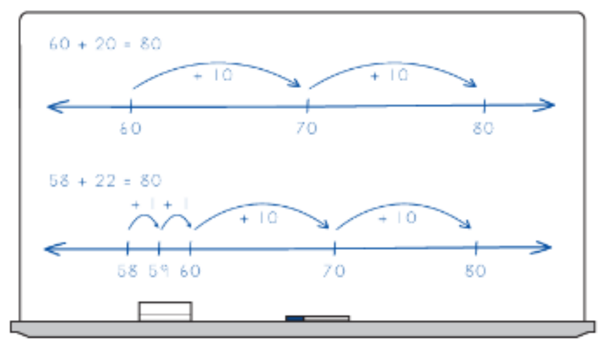
Day 15: Buckets of Beans In this session students use the open, or empty, number line to add 2-digit numbers within 100. The session builds upon the farmers' market context developed in previous sessions. In this case, students are told that beans are sold by length at 1¢ per cube length. Each color bean comes in a different length. Students are given various combinations of beans and asked to determine the sales price using an open number line.



Week 4: This is a three-session module in which students identify, describe, and extend the counting-by-2s pattern, using a class-created chart. The activities in this module provide opportunities to consider odd and even numbers in context, and provide early exposure to the concept of multiplication as repeated addition. Later in the school year, second graders will do a similar set of activities revolving around the 3s counting pattern.

Day 16: Turning Vines into Ropes Today, Jack's adventures with measuring continue as his uncle advises him to tie some of the beanstalk vines into ropes. To help Jack, students add the lengths of various vines to find out how long they will be when they're joined. Once again, the open number line is used to model and solve the problems.

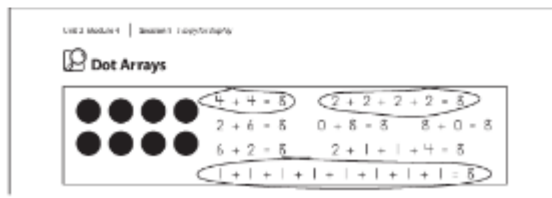


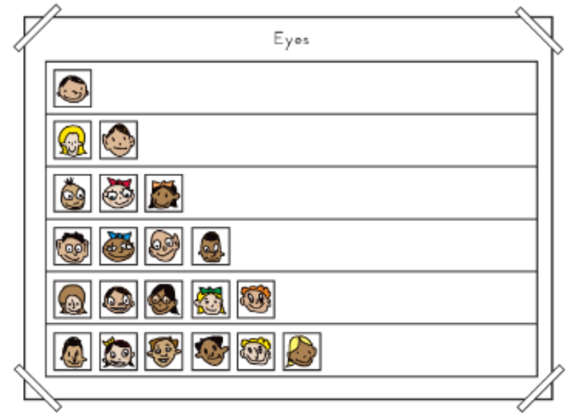


Day 17: Unit 2 Post-Assessment Students spend the first part of this session taking the Unit 2 Post-Assessment. After they complete

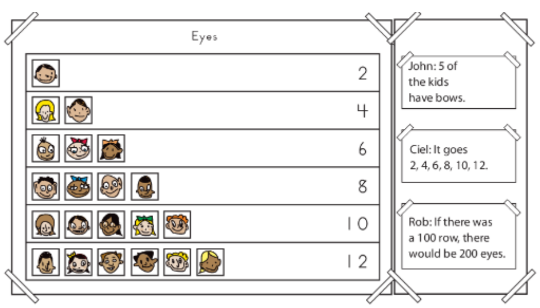
the assessment, they turn in their papers, get their folders, and choose a Work Place to do quietly while their classmates finish the assessment.

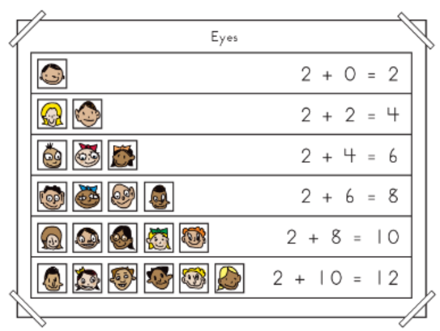
Day 18: Thinking About Twos Students examine, discuss, and write equations to match a collection of dot arrays. Then they brainstorm a list of things that come in 2s. They select one of the ideas—eyes, for instance—by class vote. Then each student draws a picture of the selected idea and mounts it on a class chart that illustrates a pattern of counting by 2s.





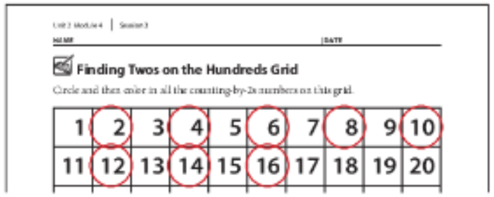
Day 19: Examining the Twos Chart Students use the Twos Chart from the previous session to discuss observations about the pattern they created. After a group discussion of attributes of the chart, the teacher poses more questions about extending the pattern. Students then work independently to write their own observations.





Day 20: Extending the Twos Chart Students use the Twos Chart again to extend counting by 2s through 100 on a hundred grid. They

then work individually to write observations about the resulting patterns found in their work and to answer questions related to counting by 2s.


Unit 2 Module 4 | Session 3

NAME | DATE

Finding Twos on the Hundreds Grid

Circle and then color in all the counting-by-2s numbers on this grid.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)
- The use of the *Jack and the Beanstalk* text provides students with a context through which they build a concrete representation of the number line. This will be the basis for developing understanding of the abstract open number line and relates directly to length measurement tools we use in our daily lives.
- Students use the context of eyes, hands, etc. to discover things that are in pairs in the real world. They use this content to explore odd and even numbers.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play.
- See "Game Variations" in work place guides.
- See "Assessment and Differentiation" in work place teacher masters.

Support:
- When applicable give students smaller numbers to practice the strategies.
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall.
- See "Game Variations" in work place guides.
- See "Assessment and Differentiation" in work place teacher masters.

MLL (Multilingual Learners)**:**
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.

Assessments

Include an overview of authentic assessments

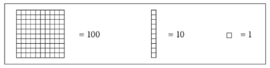
Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

Unit 2 Pre-assessment:

NAME | DATE

Unit 2 Pre-Assessment page 1 of 5

1 How many units?



a Total units _______ **b** Total units _______

2 What number am I?

a	I have 2 tens and 5 ones.	What number am I? ______
b	I have 5 tens and 2 ones.	What number am I? ______
c	I have 12 tens.	What number am I? ______
d	I have 2 hundreds and 3 tens.	What number am I? ______
e	I have 1 hundred and 5 ones.	What number am I? ______

3 534

a What is the digit in the **hundreds** place? _______

b What is the digit in the **tens** place? _______

c What is the digit in the **ones** place? _______

NAME | DATE

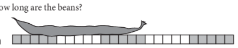
Unit 2 Pre-Assessment page 2 of 5

4 Put a loop (or loops) around 24 dots, in two different ways.

a **b**

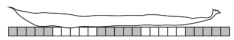
5 How long are the beans?

a



Gray bean: _______ squares

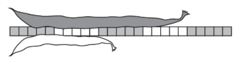
b



White bean: _______ squares

6 Which bean below is longer? Circle the answer:

gray bean white bean



How much longer? _______ squares

(continued on next page)

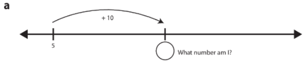
NAME | DATE

Unit 2 Pre-Assessment page 3 of 5

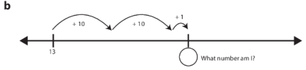
7 Circle the 26th square.

8 Write the number that belongs in the circle under each of the number lines below.

a

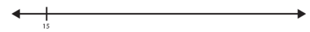


b



9 On the number line below, put your pencil on 15.

- Take a skip-jump of 10, and mark where you landed with the correct number.
- Take another skip-jump of 10, and mark where you landed with the correct number.



NAME | DATE

Unit 2 Pre-Assessment page 4 of 5

10 Solve the addition problems on pages 4–5. For each problem:

- Show all your work. Use the open number line to help if you like.
- Use numbers and/or words to tell about your strategy.

a 38 + 10 = _______

b 98 + 10 = _______

c 38 + 42 = _______

NAME | DATE

Unit 2 Pre-Assessment page 5 of 5

d 49 + 51 = _______

e 64 + 16 = _______

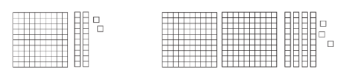
f 89 + 31 = _______

Unit 2 Checkpoint

NAME | DATE

Place Value Checkpoint page 1 of 2

1 How many units in all? _______ 2 How many units in all? _______



3 How many units in all? _______ 4 How many units in all? _______

5 What number am I? You may use blocks or linking cubes to help.

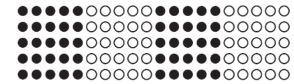
a	I have 2 tens and 3 ones.	What number am I? _______
b	I have 1 ten and 7 ones.	What number am I? _______
c	I have 5 tens and 8 ones.	What number am I? _______
d	I have 1 ten and 12 ones.	What number am I? _______
e	I have 1 hundred, 4 tens, and 2 ones.	What number am I? _______
f	If you gave me 3 more tens, I would be 81.	What number am I? _______
g	I have 2 hundreds and 3 ones.	What number am I? _______
h	I have 1 hundred, 12 tens, and 2 ones.	What number am I? _______

(continued on next page)

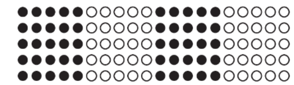
NAME | DATE

Place Value Checkpoint page 2 of 2

6 Put a circle (or circles) around 62 dots.



7 Put a circle (or circles) around 62 dots in a different way.



8 643

a What is the digit in the **hundreds** place? _______

b What is the digit in the **tens** place? _______

c What is the digit in the **ones** place? _______

9 294

a What is the digit in the **hundreds** place? _______

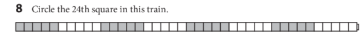
b What is the digit in the **tens** place? _______

c What is the digit in the **ones** place? _______

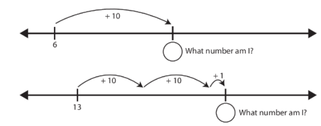
NAME | DATE

Unit 2 Post-Assessment page 4 of 6

8 Circle the 24th square in this train.



9 Write the number that belongs in the circle under each of the number lines below.



10 On the number line below, put your pencil on 15.

- Take a skip-jump of 10 on the line, and mark where you landed with the correct number.
- Take another skip-jump of 10 on the line, and mark where you landed with the correct number.

NAME | DATE

Measuring Checkpoint page 2 of 2

3 Which bean is longer?

Circle the answer: gray bean white bean

How much longer? _______ squares

4 How long are the beans?

a Gray bean: _______ squares

b White bean: _______ squares

Unit 2 Post Assessment:

NAME | DATE

Measuring Checkpoint page 1 of 2

1 How long are the beans?

a Gray bean: _______ squares

b White bean: _______ squares

c Gray bean: _______ squares

d White bean: _______ squares

2 How many squares long is the snake?

The snake is _______ squares long.

(continued on next page)

NAME | DATE

Unit 2 Post-Assessment page 3 of 6

4 629

a What is the digit in the **hundreds** place? _______

b What is the digit in the **tens** place? _______

c What is the digit in the **ones** place? _______

5 Put a loop (or loops) around 32 dots in two different ways.

a b

6 How long are the beans?

a Gray bean: _______ squares

b White bean: _______ squares

7 Which bean is longer? Circle the answer:

gray bean white bean

How much longer? _______ squares

(continued on next page)

NAME | DATE

Unit 2 Post-Assessment page 2 of 6

2 How many units in all?

a I already have 32 units. Then my friend gives me this many more.

How many units do I have in all?

Total units _______

b I already have 21 units. Then my friend gives me this many more.

How many units do I have in all?

Total units _______

3 What number am I?

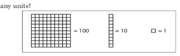
a	I have 1 ten and 5 ones.	What number am I? _______
b	I have 5 tens and 3 ones.	What number am I? _______
c	I have 13 tens.	What number am I? _______
d	I have 2 hundreds and 4 tens.	What number am I? _______
e	I have 2 hundreds and 5 ones.	What number am I? _______

(continued on next page)

NAME | DATE

Unit 2 Post-Assessment page 1 of 6

1 How many units?



a Total units _______

b Total units _______

(continued on next page)

NAME | DATE

d 49 + 51 = _______

e 64 + 16 = _______

f 89 + 31 = _______

NAME | DATE

11 Solve each of the addition problems below using the open number line.

a 38 + 10 = _______

b 97 + 10 = _______

c 48 + 32 = _______

(continued on next page)

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Measuring Checkpoint
- Place Value Checkpoint
- Unit 2 Post-Assessment

Unit 2 Place Value Checkpoint

Item and Correct Answer	CCSS	Points Possible	Student Name
1 Identifies how many units there are in a collection of base ten pieces showing 4 strips and 4 units. *44*	2.NBT.1	**1 pt.**	
2 Identifies how many units there are in a collection of base ten pieces showing 8 strips and 7 units. *87*	2.NBT.1	**1 pt.**	
3 Identifies how many units there are in a collection of base ten pieces showing 1 mat, 2 strips and 2 units. *122*	2.NBT.1	**1 pt.**	
4 Identifies how many units there are in a collection of base ten pieces showing 2 mats, 4 strips, and 3 units. *243*	2.NBT.1	**1 pt.**	
5 Reads 2- and 3-digit numbers written in expanded notation and rewrites them in standard notation. 23, 17, 58, 22, 142, 51, 203, 222	2.NBT.3	**8 pts.** • 1 pt. for each correct answer	
6 Loops 62 dots on a 5 by 20 array of dots. *Students' responses will vary. Examples: Loops 5 rows of 10 dots, then another row of 10 and 2 more; Loops 3 rows of 20 dots and 2 more; Loops 12 columns of 5 dots and 2 more.*	2.OA.4	**1 pt.** • 1 pt. for a viable response (Do not award a point for 62 dots circled 1 by 1 at random; look for sets larger than 1s.)	
7 Loops 62 dots on a 5 by 20 array of dots in a different way than in problem 6. *Students' responses will vary. Examples: Loops 5 rows of 10 dots, then another row of 10 and 2 more; Loops 3 rows of 20 dots and 2 more; Loops 12 columns of 5 dots and 2 more.*	2.OA.4	**1 pt.** • 1 pt. for a viable response (Do not award a point for 62 dots circled 1 by 1 at random; look for sets larger than 1s.)	
8 Identifies the number of hundreds, tens, and ones in 643. *6 hundreds, 4 tens, 3 ones*	2.NBT.1 2.NBT.3	**3 pts.** • 1 pt. for each correct answer	
9 Identifies the number of hundreds, tens, and ones in 294. *2 hundreds, 9 tens, 4 ones*	2.NBT.1 2.NBT.3	**3 pts.** • 1 pt. for each correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**20 pts.**	

* **Meeting Standard:** 15–20 points (75–100% correct) **Approaching Standard:** 10–14 points (50–74% correct) **Strategic:** 5–9 points (25–49% correct) **Intensive:** 4

Unit 2 Measuring Checkpoint

Item and Correct Answer	CCSS	Points Possible	Student Name
1a–d Finds the length of 4 beans by comparing each to a train of iterated squares. *a: 20 squares, b: 23 squares, c: 12 squares, d: 18 squares*	1.MD.2 2.NBT.2	**4 pts.** 1 pt. for each correct answer	
2 Finds the length of a "snake" built of iterated squares organized into groups of 5. *36 squares*	1.MD.2 2.NBT.2	**1 pt.**	
3 Identifies which of 2 beans is longer, and determines exactly how many units longer. *The gray bean is longer by 8 squares.*	1.MD.2 2.MD.4	**1 pt.**	
4 Determines the length of 2 strips using iterated squares. Both strips are placed in the middle of a train of squares rather than even with the start of the train. a: 12 squares, b: 18 squares	1.MD.2	**2 pts.** 1 pt. for each correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**8 pts.**	

* **Meeting Standard:** 6–8 points (75–100% correct) **Approaching Standard:** 4–5 points (50–74% correct) **Strategic:** 2–3 points (25–49% correct) **Intensive:**

Unit 2 Post-Assessment Scoring Guide page 1 of 2

Item and Correct Answer	CCSS	Points Possible	Student Name
1a–b Identifies how many units there are in two different collections of base 10 pieces. *134, 251*	2.NBT.1	**2 pts.** • 1 pt. for each correct answer	
2a–b Counts on from a given 2-digit number to determine how many base ten units there are in all. *166, 272*	2.NBT.1 2.NBT.7	**2 pts.** • 1 pt. for each correct answer	
3a-e Reads 2- and 3-digit numbers written in expanded notation and rewrites them in standard notation. *15, 53, 130, 240, 205*	2.NBT.3	**5 pts.** • 1 pt. for each correct answer	
4a-c Identifies the number of hundreds, tens, and ones in 629 *6 hundreds, 2 tens, 9 ones*	2.NBT.1 2.NBT.3	**3 pts.** • 1 pt. for each correct answer	
5 Loops 32 dots in 2 different ways on a 4 by 16 array of dots. *Students' responses will vary. Examples: Loops 4 rows of 8 dots or 8 columns of 4 dots; Loops 2 rows of 16 dots; Loops 3 rows of 10 dots and 2 more dots in another row.*	2.OA.4 2.MP.7	**2 pts.** • 1 pt. for each viable response (Do not award a point for 32 dots circled 1 by 1 at random; look for sets larger than 1s.)	
6a–b Finds the length of 2 beans by comparing each to a train of iterated squares. *Gray bean = 15 squares; White bean = 16 squares*	1.MD.2 2.MP.7	**2 pts.** • 1 pt. for each correct answer	
		Subtotal page 1	

Item and Correct Answer	CCSS	Points Possible	
7 Identifies which of 2 beans is longer, and determines exactly how many units longer. *The gray bean is longer by 8 squares.*	1.MD.2 2.MD.4 2.MP.7	**1 pt.**	
8 Circles the 24th square in a train marked off in multiples of 5.	1.MD.2 2.MP.7	**1 pt.**	
9a–b Adds numbers on an open number line. *6 + 10 = 16; 13 + 10 + 10 + 1 = 34*	2.NBT.5 2.MD.6	**2 pts.** • 1 pt. for each correct answer	
10 Makes a skip-jump of 10 from 15 on an open number line and reports landing on 25; takes a second skip-jump of 10 from 25 and reports landing on 35.	2.NBT.5 2.MD.6	**2 pts.** • 1 pt. for each correct answer	
11a–f Adds 6 pairs of double-digit numbers and shows work. *48, 107, 80, 100, 80, 120*	2.NBT.5	**12 pts, 2 for each problem** • 1 pt. for showing a viable strategy that could lead to the correct answer • 1 pt. for the correct answer	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**34 pts.**	

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 3: Addition & Subtraction Within One Hundred
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

2.OA.A.1- Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

2.OA.B.2- Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two

one-digit numbers.
2.OA.C.3- Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.

Supporting Standards:
2.NBT.A.1- Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones.
2.NBT.A.2- Count within 1000; skip-count by 5s, 10s, and 100s.
2.NBT.A.3- Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.
2.NBT.A.4- Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and <

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
● Solve add to, taking from, putting together, taking apart, and comparing story problems with unknowns in all positions.	● We can use addition and subtraction within 100 to solve one, two-step story problems with drawings and equations with a symbol for the unknown number.
● Fluently add and subtract from memory all sums of two one-digit numbers.	● Addition is the act of putting quantities together and subtraction is the act of taking them apart or comparing their magnitude.
● Add and subtract within 100.	● We can use mental strategies and knowledge of basic facts to solve addition and subtraction facts within 100 using strategies.
● Determine whether a number is odd or even.	● A group of objects is even if you can pair objects or count

	them by 2s if; there is one left over it is odd.
• Write equations for double facts.	• An equation to express an even number is a sum of two equal addends.
• Understand place value of all 3-digit numbers.	• Three digits of a three-digit number represents amounts of hundreds, tens, and ones.
• Count within 1000 and by 5's, 10s, and 100s.	• Number patterns through 100 can be extended through 1000.
• Read and write numbers to 1000.	• Numbers to 1000 can be written with base-ten numerals, number names, and expanded form.
• Compare two three-digit numbers using >, =, < symbols to record results.	• Numbers can be compared to one another based on their magnitude. The symbols <, > or = are used to express these comparisons.
• Add up to four two-digit numbers using strategies.	• Various strategies can be used to find sums of multiple two-digit numbers.
• Measure the length of an object and to determine how much longer one object is than another.	• Objects can be measured with tools from end to end with no gaps or overlaps. The difference in length between two objects can be determined using subtraction.
• Select and use appropriate tools for measuring.	• Different types of measurement require the use of different tools.
• Express length and length difference in terms of a standard-length unit.	• Length is measured in inches, feet, yards, and miles. Metric units are millimeters, meters, and kilometers.
• Estimate lengths.	• Using benchmarks, we can approximate the length of an object.

• Use addition and subtraction within 100 to solve word problems involving lengths of the same unit.	• Measurement is a real-world application of addition and subtraction situations.
• Represent whole numbers as lengths from 0 on a number line with equally spaced points and whole number sums and differences within 100 on a number line.	• A numberline is a length model that can be used to locate specific numbers in relation to others and to model addition and subtraction.
• Create a visual representation of a data set with up to four categories.	• A picture or bar graph (with a single unit scale) can be used to show data in a visual way.
• Solve problems using information presented in a bar graph.	• Graphs make data analysis easier.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can strategies help us add and subtract?	1. Strategies can help us build a better understanding of the relationships between numbers and operations. Some strategies that can help us add and subtract are using place value, properties of operations, composing and decomposing numbers, and the relationship between addition and subtraction, creating easier, but known results.
2. What are efficient methods for finding sums and differences?	2. Flexible methods of computation involve grouping numbers in strategic ways, such as by place value, properties of operations, composing/decomposing. etc.
3. How do we decide which tool to use to measure something?	3. The choice of measurement tool depends on the measurable attribute, the size of the object, and how precise we need the measurement.

4. What do we measure?	4. Objects have attributes that we measure. such as length, width, height, weight, etc.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.b:** Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Informational Texts:
• **Informational**
  ○ More M&Ms Math
• **Media:**
  ○ Timelapse M&M video
 	
Children's Literature:
• Arctic Fives Arrive
• Centipede's 100 Shoes
• Data and Graphing Books
 	
Online Resources / Websites:
• MLC Number Line App
• Grouping and Grazing
• Whack A Mole
• MLC Number Pieces App
• Create a Graph

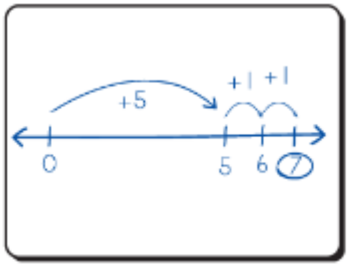
Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Bar graph:** a graph using vertical or horizontal bars to show how large specific values are. **Compare:** to examine to note similarities and differences; to determine whether numbers are greater than, less than or equal.

Data: items of information; may include facts, numbers, or measurements.
Difference: the result of subtracting one number from another number; the amount by which one number is greater or less than another number.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Even: a number which is divisible by 2 and generates a remainder of 0 is called an even number.
Expanded notation: the term given in elementary mathematics education for the expansion of a positive integer in the form, i.e., as a sum of appropriate powers of 10 (the base of the expansion) times its digits (in the case of base-10, decimal digits).
Greater than: a symbol used to indicate that the number on the left is greater than the number on the right.
Height: how tall something is; the measurement from top to bottom of an object or a shape.
Left over: the amount "left over" after performing some computation.
Length: how long something is.
Less than: a symbol used to indicate that the number on the left is less than the number on the right.
Measurement: a number that shows the size or amount of something.
Multiple: the numbers you get when you multiply a certain number by an integer.
Number line: a diagram in which numbers are represented as points on a number line.
Odd: An odd number is a number which is not divisible by 2. The remainder in the case of an odd number is always "1".
Ones: the numbers 0 through 9; also refers to the ones place.
Open number line: A blank number line on which children can mark points or numbers that are useful for solving problems.
Place value: the value a digit has because of its place in a number; the name of the position of the number such as tens or ones.
Prediction: a reasonable guess.
Share: on dividing the whole or a group of objects into equal parts.
Split strategy: a strategy that partitions (splits) numbers into smaller addends.
Subtract: to take one quantity away from another or find the difference between two quantities.
Tens: the numbers 10-99; also refers to the tens place.
Sum or total: the result of adding two or more numbers.

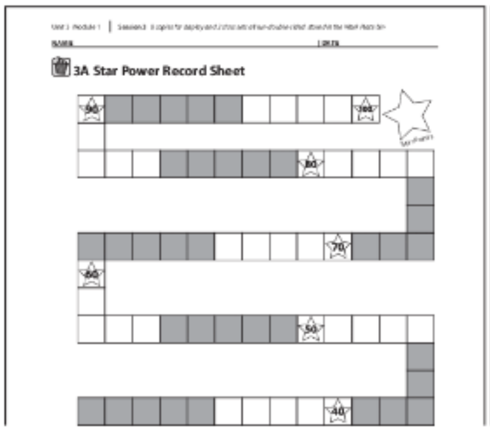
Learning Plan

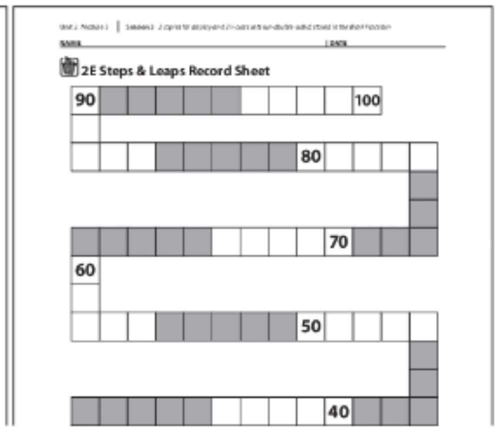
Overview and Key Learning Events and Instruction Per Week

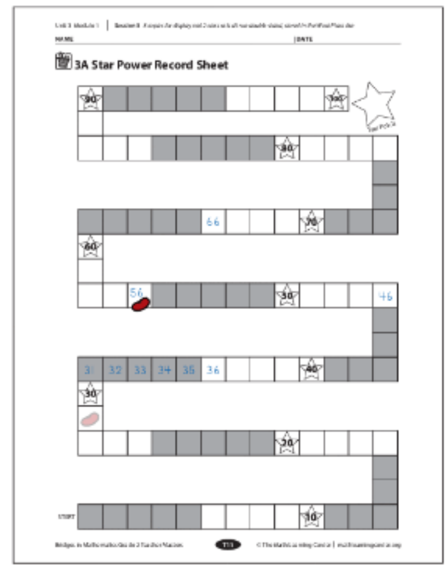
Unit 3 focuses on strategies for multi-digit addition and subtraction within the range of 0-100.

Learning Tasks Per Week (Including Instructional Strategies)
Week 1: Tens and Ones: Over the next five sessions, students will work with numbers in the range of 0 to 100. Both in the abstract, and with physical models (craft sticks), students count, combine, and organize objects and numbers based on mathematical concepts such as place value, multiples of 5 and 10, etc. While making "skip-jumps" on the number line, students focus on increments of 5 and 10. While organizing and counting a group of objects, students explore place value concepts into the hundreds. The teacher flashes images to help students quickly recognize benchmark amounts of 5 and 10 and then use those benchmarks to combine numbers and find the total number of objects represented. **Lesson One:** Unit 3 Pre-Assessment Students take the Unit 3 Pre-Assessment today. They go out to Work Places as they finish their assessments. Finally, the teacher introduces and assigns the Steps & Leaps Home Connection. **Lesson Two:** Skip Trips Students use "skip-jumps" of 1, 5, and 10 to reach a given target on the number line. The goal of the activity is to arrive at the intended target by using as few skip-jumps as possible. Students complete a related worksheet in their Student Books, and then spend any time remaining in the session at Work Places. 

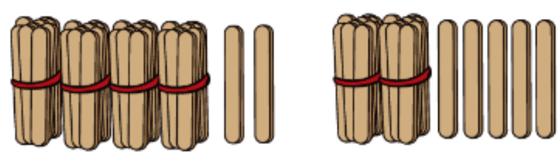
Lesson Three: Introducing WorkPlace 3A Star Power In this session, the teacher introduces WorkPlace 3A Star Power, which is very similar to Steps & Leaps with one important difference: students can choose to take their steps and leaps in any order. Students play the game in pairs and then go out to Work Places. Finally, the teacher introduces and assigns the Puzzles & Shapes Home Connection. Introducing WorkPlace 3A Star Power The Game Star Power is a version of the Steps & Leaps game. Players take turns rolling two dice and spinning the spinner to move toward 100. Players write the numbers on all the spaces they land on along the way and circle any stars they land on. The game continues until one of the players reaches or crosses 100 and wins. Then the total number of Star Points are calculated by counting all the stars that are circled. Players add their Star Points and record them on a class score sheet to compare with other teams.

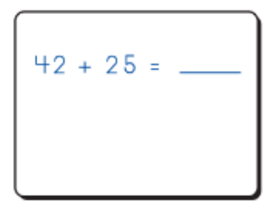




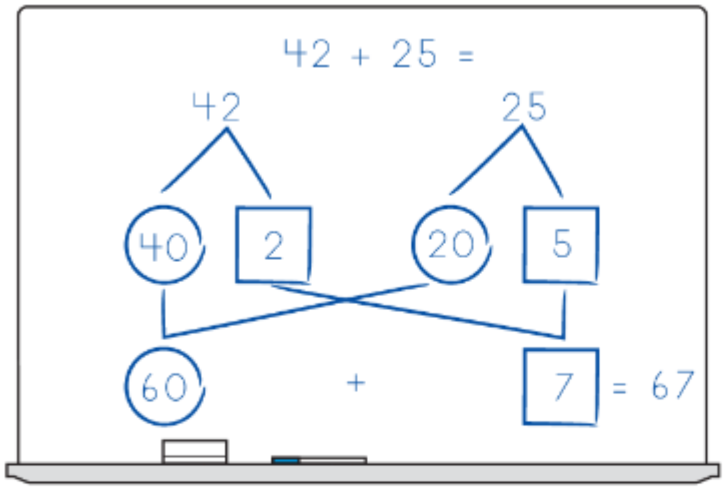


Lesson Four: Sticks & Bundles Today students work together to estimate and then count a large collection of craft sticks, regrouping the sticks into hundreds, tens, and ones as needed. Then the teacher poses several double-digit addition problems to the class. Students solve each problem, and then share solutions and strategies.

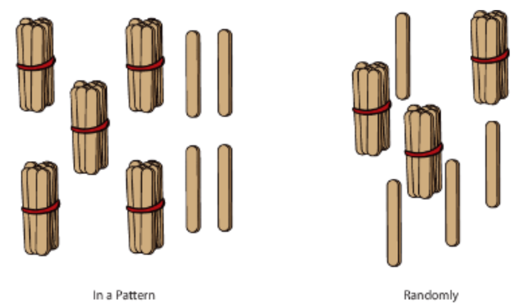




The teacher highlights the splitting strategy: first adding the tens, then the ones, and then adding the 10s and 1s.



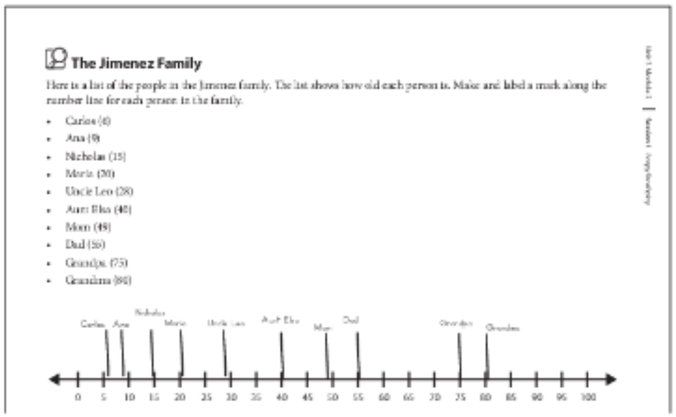
Lesson Five: Stick Flash During this session, students continue to develop the splitting strategy to add 2-digit numbers within 100. The teachers quickly flash different quantities of bundles and sticks and ask students to report how many they saw. Next, the teacher briefly shows two collections of bundles and sticks at the same time and hides them, asking students to report the total.

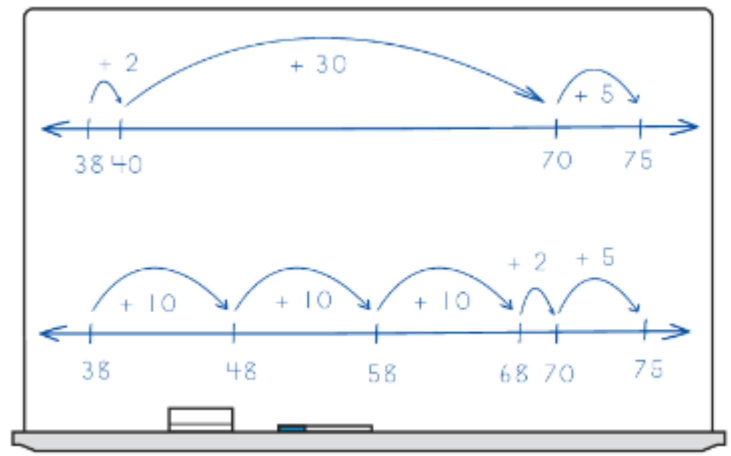


A new Workplace that involves double-digit addition is introduced. Finally, the teacher assigns the Subtracting on the Line & Solving Story Problems Home Connection.

Week 2: In this module, students develop a facility with the number line as a model for addition and subtraction within the range of 0 to 100. Additionally, students are asked to model, and subsequently solve, story problems that require either addition or subtraction with double-digit numbers. Students are encouraged to develop confidence with the "skip-jump" strategy by moving in both directions on the number line by increments of 1, 5, and 10.

Lesson One: Session 1 How Much Older? Students use the number line to add and subtract within the range of 0 to 100. Specific focus is placed on subtraction as students compare the ages of family members in story problem contexts.





Lesson Two: Solving Problems on the Open Number Line In this session, students use the open number line to model and solve three double-digit story problems. Students move from counting by ones to making jumps of 10 on the open number line.

$38 + \square = 75 \qquad 75 - \square = 38$

The session ends with a visit to Workplaces if time allows. Finally, the teacher introduces and assigns the Family Age Number Line Home Connection.

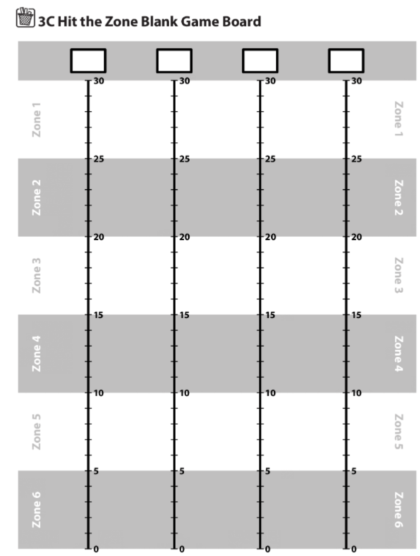
Lesson Three: Height & Length Problems Students work as a group with the teacher to compare three different solutions to a story problem involving length using the open number line.

Story Problems

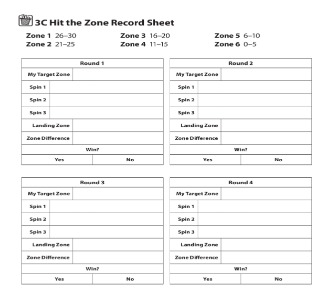
Josh and his dad are driving to the city. It is 75 miles away. They have already gone 38 miles. How many more miles do they have

to drive?
Maria Jose wants to buy a bike that costs $72.00. So far, she has saved $26.00. How much more money does she need to save?
Pablo had 39 baseball cards. He got some more baseball cards for his birthday. Now Pablo has 63 baseball cards. How many did Pablo get for his birthday?

Students then work in pairs or individually to solve two related story problems using the open number line. Students do Work Places as they finish and then come back together as a class to discuss solutions.



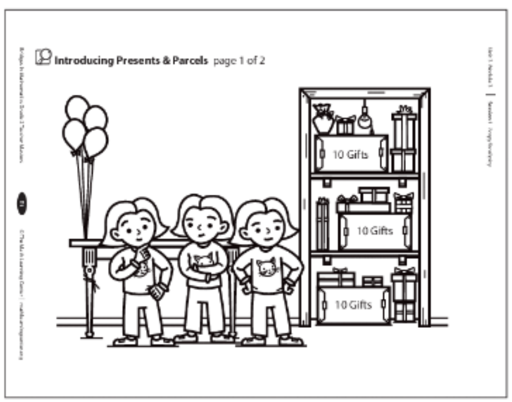
Lesson Four: Introducing WorkPlace 3C Hit the Zone The teacher introduces a new Workplace game featuring subtraction on the number line, by playing against the class and having students track all the moves and results for their team in their Student Books. Then the teacher sends students out to do Work Places, including the one just introduced. Finally, the teacher introduces and assigns the Adding, Counting & Solving Problems Home Connection.
Introducing WorkPlace 3C Hit the Zone Each player begins by writing his initials at the top of the game board to claim one of four lines that run the length of the board. Next, players take turns rolling a die to determine which of six zones on the board they need to reach to win. Players then take turns spinning a numbered spinner that determines how far they can move along their line. After three spins each, using a different spinner each time, the player who comes closest to hitting his or her designated zone wins the round.

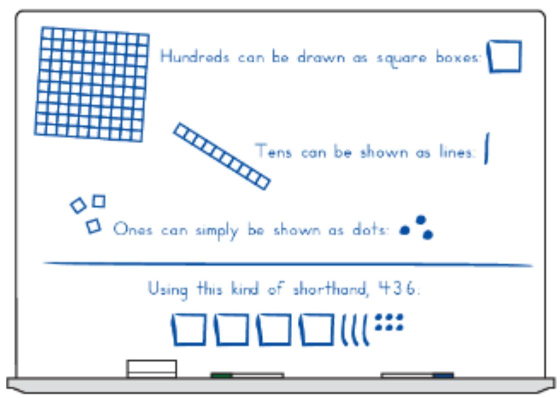


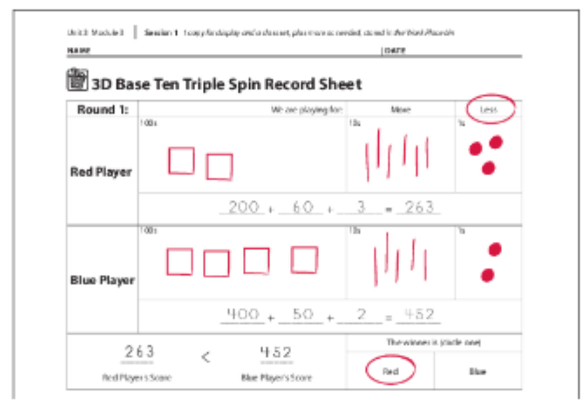
Lesson Five: Addition & Subtraction Checkpoint This session provides a checkpoint for much of the content covered in the first two modules of Unit 3. Students locate, mark, and identify numbers on a line, use the open number line to model and solve double-digit subtraction problems, use the fewest skip-jumps of 1, 5, and 10 to reach different points on the number line, and solve several double-digit addition problems. When finished with the assessment, students turn in their work and go out to Work Places.

Weeks 3 and 4: Over the next seven sessions, students work with 2-digit numbers and problem solving by exploring scenarios that involve single presents (representing 1s) and parcels of presents (representing 10s). Students learn to identify the key information in a story problem, work as a group and individually to solve story problems, create their own story problems, and then solve the problems created by their classmates. Students quickly learn that while counting by 1s can be used to solve these problems, working in 10s and 1s is far more efficient. Two new Workplaces are introduced to provide students practice with modeling, reading, and comparing 3-digit numbers, as well as solving addition facts to 20.

Lesson One: Introducing Presents & Parcels This session introduces the Presents & Parcels scenario and sets the stage for the story problems students will pose and solve over the next seven sessions. In the second half of the session, students learn to play Work Place 3D Base Ten Triple Spin, a deceptively simple strategy game that may puzzle some students at first but provides good opportunities for building triple-digit number sense. Introducing WorkPlace 3C Base Ten Triple Spin Players spin for a digit 2–7 and decide if they want that spin to represent 1s, 10s, or 100s. As they decide, they take the appropriate base ten area pieces and continue spinning until each player has built a 3-digit number. The players then sketch their base ten area pieces on a shared record sheet, write their numbers in expanded form, and compare the numbers to determine the winner.
Lesson Two: Solving Picture Problems In this session, students independently

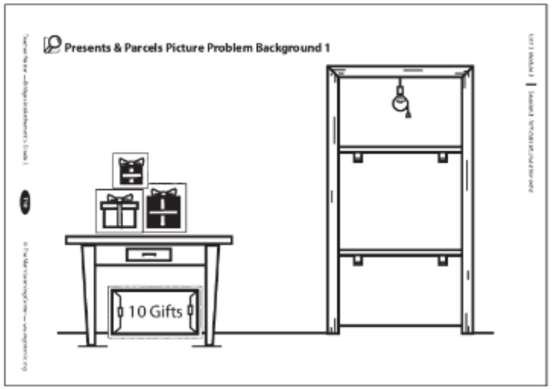


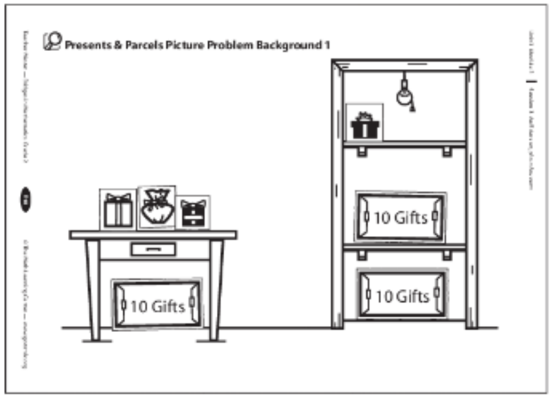




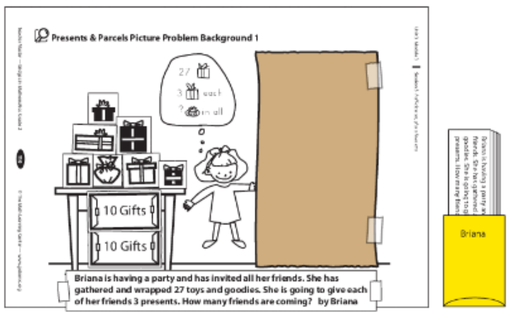
solve a collection of six story problems, using the written and visual information to solve the problems. As they solve each problem, they come back together as a group to discuss solutions and strategies.

Lesson Three: Creating Picture Problems, Part 1 This session is the first of two that will challenge students to create their own Presents & Parcels picture problems. In this session, students each create the scene for the story problem they will write next session.

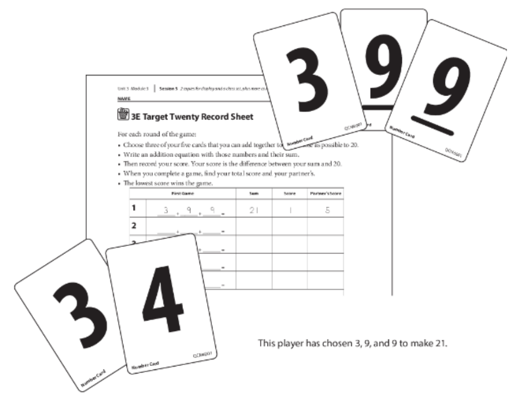




Lesson Four: Creating Picture Problems, Part 2 Students continue the work they began in Session 3. They finish their picture problems, write their stories, and add talk bubbles, question marks, and other needed clues. After the session, the teacher types of each student's story and prepares them for problem-solving activities during the remaining sessions of the module.



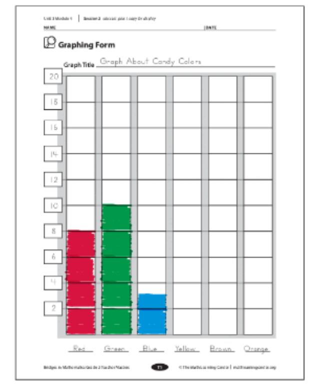
Lesson Five: Solving Student-Posed Story Problems Before this session, the teacher selects two or three students' picture problems for the class to work on together. As each of these problems is presented, students show their strategies and solutions on paper. Then they share their thoughts with others in the group. Finally, the teacher introduces a new Workplace, Target Twenty, an addition facts game. Introducing Workplace 3E Target Twenty Players draw five cards from a deck and then choose three of the cards to add together to get as close as possible to 20. Then they find the difference between their score and 20. The winner is the player with the lowest score after five rounds.



Lesson Six: Shopping for Story Problems Today the teacher models the procedure for choosing and solving story problems from the collection the class has generated. The students then select and work one problem at a time, completing as many as they can during this session. The work from this session and the next can be scored and saved as a Work Sample.

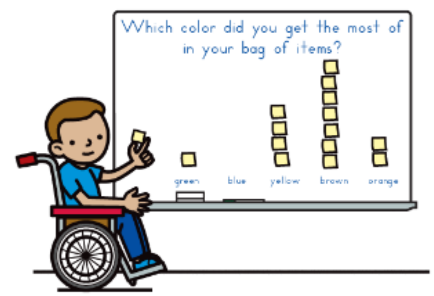
Lesson Seven: Unit 3 Post-Assessment Students complete the Unit 3 Post-Assessment today. As they finish and turn in their assessments, they return to shopping for story problems as they did in Session 6.

Week 5: In this module students investigate the frequency with which various colors show up in bags of objects. While the sessions are written with small bags of candy-coated chocolates in mind, teacher-prepared bags of colored buttons, pattern blocks, or Unifix cubes can be used. Counting the numbers of each color in individual bags, graphing, comparing, and then examining class data enable students to make predictions about the colors likely to turn up most frequently in all bags. As students graph class data, they discover that the graphing form doesn't have enough rows to accommodate all the quantities without assigning each box a value of more than one, so chunking becomes a valuable skill needed to complete the task.



Lesson One: The Many Colors Project, Part 1 This session is the first of three in the The Many Colors Project, an activity designed to help students develop number sense in the context of a statistical investigation. In today's session students predict the number of each color they will find in a bag of objects such as buttons or candy. Then they find the frequencies with which certain colors appear, and work with a partner to count and share the items in the bag.

Lesson Two: The Many Colors Project, Part 2 Students create graphs to show how many of each color they found in their bags of items. The class works together to create a scale that is appropriate for the data and to label the graph so that it is clear to others what is being presented. The session ends with a brief discussion of problems that could be solved using the graphs.



Lesson Three: The Many Colors Project, Part 3 In this final session of the Many Colors Project, students analyze their own data, write equations based on another student's data, and create and analyze a class graph using the data from everyone's results.

Interdisciplinary / Real World / Global Connections

- In this unit students are provided with opportunities to read, analyze, and create different types of graphs and data sets,

allowing them to see the connections to data, probability and graphs in the real world.
- Story problems are a natural way to give context to addition and subtraction problems. In this unit the presents and parcels, pictures and story problems allow students to become more familiar with the different ways we encounter these operations in everyday situations.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play.
- See "Game Variations" in workplace guides.
- See "Assessment and Differentiation" in workplace teacher masters.

Support:
- Ensure instructional materials are systematic and explicit. They should include numerous clear models of easy and difficult problems, with accompanying teacher think alouds.
- Provide students with opportunities to solve problems in a group and communicate problem-solving strategies.
- Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type.

- Students should work with visual representations of mathematical ideas.
- If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulations first. (Include the next line for middle school and older students only) Although this can also be done with students in upper elementary and middle school grades, use of manipulatives with older students should be expeditious because the goal is to move toward understanding of and facility with visual representations and finally to the abstract.
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution.
- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review. Intervention for facts
- Provide about 10 minutes per session of instruction to build quick retrieval of basic arithmetic facts. Consider using technology, flashcards, and other materials for extensive practice to facilitate automatic retrieval.
- For students in K -2 explicitly teach strategies for efficient counting to improve the retrieval of mathematics facts.

MLL (Multilingual Learners)**:**

- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words.
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.

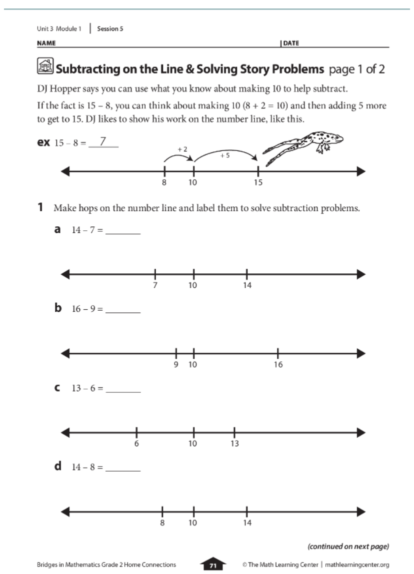
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work
- Number Strings



Unit 3 Module 1 | Session 5

NAME ____ | DATE ____

Subtracting on the Line & Solving Story Problems page 1 of 2

DJ Hopper says you can use what you know about making 10 to help subtract.

If the fact is 15 – 8, you can think about making 10 (8 + 2 = 10) and then adding 5 more to get to 15. DJ likes to show his work on the number line, like this.

ex 15 – 8 = 7

1 Make hops on the number line and label them to solve subtraction problems.

a 14 – 7 = ____

b 16 – 9 = ____

c 13 – 6 = ____

d 14 – 8 = ____

(continued on next page)

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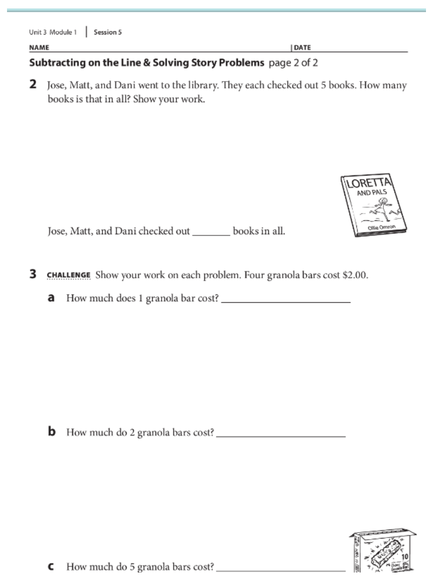


Unit 3 Module 1 | Session 5

NAME ____ | DATE ____

Subtracting on the Line & Solving Story Problems page 2 of 2

2 Jose, Matt, and Dani went to the library. They each checked out 5 books. How many books is that in all? Show your work.

Jose, Matt, and Dani checked out ____ books in all.

3 CHALLENGE Show your work on each problem. Four granola bars cost $2.00.

a How much does 1 granola bar cost? ____

b How much do 2 granola bars cost? ____

c How much do 5 granola bars cost? ____

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Addition and Subtraction Checkpoint

Unit 3 Module 2 | **Session 5** *class set, plus 1 copy for display*

NAME | **DATE**

Addition & Subtraction Checkpoint page 1 of 3

1 Fill in the missing numbers on the number line.

0 ☐ ☐ 30 40 50 ☐ 70

2 Write each number where it belongs on the number line. You will need to make n[ew] marks for some of the numbers.

5, 10, 15, 22, 30, 35

0 20 40

3 Use the number line to solve the problem. Show all your work. Then write your answer in the box.

34 – 12 = ☐

12 34

4 Use the number line to solve the problem. Show all your work. Then write your answer in the box.

45 – 21 = ☐

Unit 3 Module 2 | **Session 5** *class set, plus 1 copy for display*

NAME | **DATE**

Addition & Subtraction Checkpoint page 2 of 3

5 How many sticks in all? _______

6 Look at the two collections of sticks.

a How many sticks are in each collection? Write your answers on the lines.

__________ __________

b If you put the collections together, how many sticks are there in all? _______

7 Julia has 4 bundles and 3 sticks. If her friend gave her 2 more bundles and 9 more sticks, how many sticks would she have in all? Show your work.

8 Richard has 5 bundles and 8 sticks. If he gave his friend 3 bundles and 2 sticks, how many sticks would Richard have left? Show your work.

Unit 3 Module 2 | **Session 5** *class set, plus 1 copy for display*

NAME | **DATE**

Addition & Subtraction Checkpoint page 3 of 3

9 Use jumps of 10, 5, or 1 to go from 0 to 36. Take as few jumps as you can. Label your jumps. You can try again on the second number line if you see a way to do it in fewer jumps.

0 36

0 36

10 Use jumps of 10, 5, or 1 to go from 0 to 44. Take as few jumps as you can. Label your jumps. You can try again on the second number line if you see a way to do it in fewer jumps.

0 44

Unit 3 Post Assessment

NAME | DATE

Unit 3 Post–Assessment page 1 of 4

Answer the following questions. Show your work.

1 Bob raced his toy car three times. Each time he started where the last race ended. His car went 10 feet, then 14 more feet, then another 14 feet.

☐ Mark each distance the car traveled in feet.
☐ Label the total number of feet it ended on.

Bob raced the toy car _______ feet in all.

2 Bambam the kangaroo did the triple jump, jumping three times in a row. Each new jump began where the last jump ended. She jumped 35 feet, then another 35 feet, and then 38 feet.

☐ Mark Bambam's jumps on this number line.
☐ Label the total number of feet she ended on.

Bambam jumped _______ feet in all.

(continued on next page)

NAME | DATE

Unit 3 Post–Assessment page 2 of 4

3 Start at 0 and make jumps of 5, 10, and 20 to get up to 115. You have to use at least one jump of each length.

☐ Draw your jumps on the number line.
☐ Write the length of each jump.
☐ Label 115.

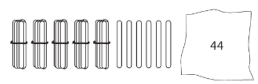
0

4 Julia counted sticks. Every time she got to 10, she made a bundle with a rubber band. How many sticks does Julia have in all?

Julia has _______ sticks in all.

5 Ana has some sticks on the table. She has 44 more sticks under the cloth. How many sticks does Ana have in all?

☐ Write an equation for this problem here. ________________________
☐ Solve the equation.
☐ Show your work.



Ana has _______ sticks in all.

(continued on next page)

NAME | DATE

Unit 3 Post–Assessment page 3 of 4

6 Sam is 15 years old. His Aunt Nancy is 100 years old. How much older is Aunt Nancy? Use the number line to solve the problem.

Aunt Nancy is _______ years older than Sam.

7 Adam is 45 years old. His grandfather Robert is 98 years old. How much older is Grandpa Robert? Use the number line to solve the problem.

Robert is _______ years older than Adam.

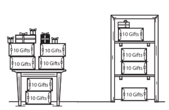
8 Sara has three lucky numbers: 17, 43, and 91. Find each of these numbers on the number line and label it to show where each of Sara's three lucky numbers are.

(continued on next page)

NAME | DATE

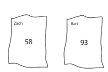
Unit 3 Post–Assessment page 4 of 4

9 Each big box contains 10 gifts. There are single gifts tied with ribbon as well. How many gifts in all are in the picture below? Write the answer on the line below.



There are _______ gifts in all in this picture.

10 The boys are playing tricks. Zach hid 58 sticks under one towel. Bart hid 93 sticks under another towel. Who hid more sticks, Zach or Bart? How many more? Show your work.



________________ hid ______ more sticks than ________________

Unit 3 Post-Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Adds 3 double-digit numbers presented in a story problem context; shows work on a number line. *38 feet*	2.OA.1 2.NBT.5 2.NBT.6 2.MD.5 2.MD.6	**2 pts.** • 1 pt. for correct representation of the problem on the number line • 1 pt. for the correct answer	
2 Adds 3 double-digit numbers presented in a story problem context; shows work on a number line. *108 feet*	2.OA.1 2.NBT.5 2.NBT.6 2.MD.5 2.MD.6	**2 pts.** • 1 pt. for correct representation of the problem on the number line • 1 pt. for the correct answer	
3 Uses a combination of 5s, 10s, and 20s to total 115; shows work on a number line. *Students' responses will vary (5 hops of 20, 1 hop of 10, and 1 hop of 5*	2.NBT.2 2.NBT.6 2.MD.6	**2 pts.** • 1 pt. for correct representation of the problem on the number line • 1 pt. for any combination of 5s, 10s, and 20s that totals 115	
4 Counts a collection of sticks grouped by 10s and 1s. *117 sticks*	1.NBT.2 2.NBT.2	**1 pt.**	
5 Counts a collection of 56 sticks grouped by 10s and 1s, and adds 44 to the collection. Shows work. *100 sticks*	1.NBT.2 2.OA.1 2.NBT.2 2.NBT.5	**3 pts.** • 1 pt. for counting the collection of sticks correctly • 1 pt. for using a viable procedure that could lead to the correct answer • 1 pt. for the correct answer	
		Subtotal page 1	

Item & Correct Answer	CCSS	Points Possible	Student Name										
6 Finds the difference between 15 and 100; shows work on a number line. *85 years*	2.OA.1 2.MD.6	**2 pts.** • 1 pt. for correct representation of the problem on the number line • 1 pt. for the correct answer											
7 Finds the difference between 45 and 98; shows work on a number line. *53 years*	2.OA.1 2.MD.6	**2 pts.** • 1 pt. for correct representation of the problem on the number line • 1 pt. for the correct answer											
8 Labels 17, 43, and 91 on a number line.	2.MD.6	**3 pts.** • 1 pt. for each number placed and labeled correctly											
9 Counts by 10s and 1s to determine how many gifts there are in the picture. *106 gifts*	1.NBT.2 2.NBT.2	**1 pt.**											
10 Compares the two quantities to determine which is more and by how much. Shows work. *Bart hid 35 more sticks than Zach.*	2.OA.1 2.NBT.5	**3 pts.** • 1 pt. for using the information in the story problem • 1 pt. for using a viable procedure that could lead to the correct answer • 1 pt. for the correct answer											
		Subtotal page 2											
		Subtotal from page 1											
TOTAL SCORE/LEVEL OF PROFICIENCY*		**21 pts.**											

* **Meeting Standard** 16–21 points (75%–100% correct) **Approaching Standard** 11–15 points (50–74% correct) **Strategic** 6–10 points (25–49% correct) **Intense** 5 points or less

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 4: Measurement
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
2.OA.A.1- Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

2.OA.B.2- Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers.
2.OA.C.3- Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.
2.OA.C.4- Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.

Supporting Standards:
2.NBT.A.4- Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons. 2.NBT.B.5- Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
2.NBT.B.6- Add up to four two-digit numbers using strategies based on place value and properties of operations.
2.MD.A.1- Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2.MD.A.2- Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen.
2.MD.A.3- Estimate lengths using units of inches, feet, centimeters, and meters.
2.MD.A.4- Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard-length unit.
2.MD.B.5- Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.
2.MD.B.6- Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
• Add and subtract within 100 to solve one- and two-step word problems, add to find the total number of objects arranged in rectangular arrays, and use symbols >, =, < to record results of comparisons.	• We can use addition and subtraction within 100 to solve one, two-step story problems with drawings and equations. Numbers can be compared to one another based on their magnitude. The symbols <, > or = are used to express these comparisons.
• Fluently add and subtract within 20 use mental strategies and within 100 using strategies.	• We can use mental strategies and knowledge of basic facts to solve addition and subtraction facts within 100 using strategies.
• Write an equation to express an even number as a sum of two equal addends and an equation to express the total in an array as a sum of equal addends.	• A group of objects is even if you can pair objects or count them by 2s; if there is one left over it is odd.
• Compare two three-digit numbers based on meanings of hundreds, tens, and ones.	• Numbers can be compared to one another based on their magnitude. The symbols <, > or = are used to express these comparisons.
• Add up to four two-digit numbers using strategies.	• Various strategies can be used to find sums of multiple two-digit numbers.
• Measure the length of an object, the length of an object twice using units of different lengths, to determine how much longer one object is than another.	• Objects can be measured with tools from end to end with no gaps or overlaps. The difference in length between two objects can be determined using subtraction.
• Select and use appropriate tools to measure.	• Different types of measurement require the use of different tools.

• Describe how two measurements of the same object relate to the size of the unit.	• Smaller units of measurement will result in a larger measurement while larger units will result in a smaller measurement.
• Estimate lengths.	• Using benchmarks, we can approximate the length of an object.
• Express length and length differences in terms of a standard-length unit.	• Length is measured in inches, feet, yards, and miles. Metric units are millimeters, meters, and kilometers.
• Represent whole numbers as lengths from 0 on a number line with equally spaced points and whole number sums and differences with 100 on a number line diagram.	• A number line is a length model that can be used to locate specific numbers in relation to others and to model addition and subtraction.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do we decide which tool to use to measure something?	1. The choice of measurement tool depends on the measurable attribute, the size of the object, and how precise we need the measurement.
2. Why is estimation an important tool?	2. Estimation is an important life skill that people use every day. Many real-life applications of math do not require exact answers. The problem situation determines the best estimation strategy to use. Estimation is also an effective strategy that promotes easy recognition of the reasonableness of an answer, to determine approximations in measuring, and for catching errors made when using calculators.
3. How do operations affect numbers?	3. Operations involve combining and taking apart numbers using a variety of approaches to arrive at a new number

	result.
4. How can analyzing operations on numbers and the results help us to become more efficient at computation?	4. Analyzing problems and their answers can help us to see patterns that can lead to a deeper understanding of number sense and shortcuts for efficient computation.

Resources

Student Technology Integration and [Correspondence to ISTE Standards](#) when Applicable:

Standard 1.5.b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

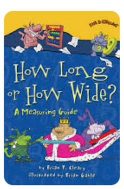
Books / Media:
Informational Text:

- For Good Measure
- MLC Pinterest Board

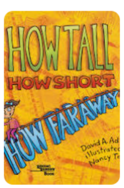
Children's Recommended Literature:

- *Jim and the Beanstalk* by Raymond Briggs.
- *How Big is a Foot?* by Rolf Myller.
- *Twelve Snails to One Lizard* by Susan Hightower.
- Inch By Inch

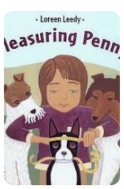
Other Texts:



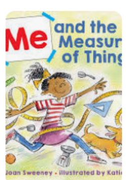
How Long or How Wide?



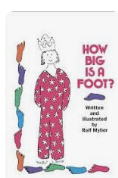
How tall, how short, how far



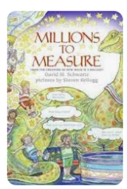
Measuring Penny



Me and the Measure of



How Big Is a Foot?



Millions to Measure

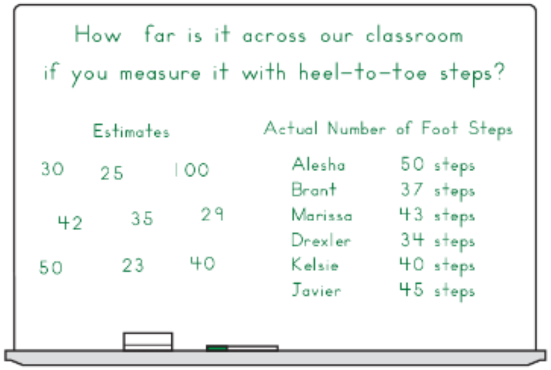
Vocabulary/Terminology

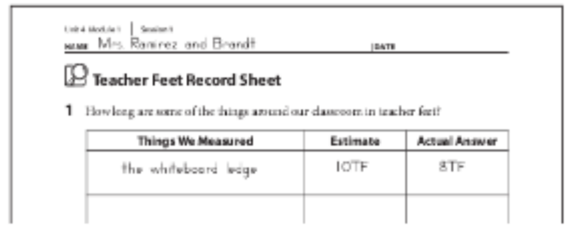
Vocabulary/Terminology with Definitions:

Addend: a number that is to be added to another number.
Addition: finding the total value of two or more numbers.
Array: a way of arranging things in rows and columns.
Circumference: the distance around the outside of a circle.
Distance: how far from each other two points or places are.
Equal: having the same value, measure, or amount as something else.
Estimate: a close guess of the actual value, usually bas
ed on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Foot: a unit of length equal to twelve inches (about .3 meter).
Height: how tall something is; the measurement from top to bottom of an object or a shape.
Inch: an Imperial or customary unit for measuring length.
Length: how long something is.
Measurement: a number that shows the size or amount of something.
Multiple: multiples are a sequence of products. using the same base number multiplied. by different numbers.
Multiply: is when you take one number and add it together several times.
Ones: the numbers 0 through 9; also refers to the ones place.
Pattern: repeated design or recurring sequence.
Row: from left to right. An arrangement of numbers or objects.
Ruler: a device or tool that is used in geometry and technical drawing, as well as engineering and construction technologies to measure the distance of a straight line.
Strategy: how you use relationships and connections between numbers to solve a problem.
Subtract: to take one quantity away from another or find the difference between two quantities.
Tens: the numbers 10-99; also refers to the tens place.
Sum or total: the result of adding two or more numbers.
Yard: A unit of length (or distance) in US units equal to 3 feet or 36 inches.
Yardstick: A graduated measuring stick three feet (0.9144 meter) long.
Width: the measurement of the distance of a side of an object.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
In Unit 4, students explore measurement from multiple entry points. Initial activities in the unit foster an understanding of the importance of standard units of measurement. Students explore measurement in the context of a giant's world, complete with inchworms, foot worms, and yard worms and have multiple opportunities to make conversions between inches, feet, and yards. A second objective of the unit is to provide informal experiences with ratios and proportional reasoning. While proportional reasoning is considered by many to be a skill reserved for work with older students, the unit again makes use of context (the giant's world) to introduce proportional reasoning in a manner that is intuitive to second grade students (e.g., "The giant's door is as tall as 5 bricks."). These activities continue to reinforce measurement concepts and skills, but also lay the important groundwork for the multiplicative comparison and proportional reasoning skills expected in later grades. The unit concludes with a module in which students identify, describe, and extend counting-by-3s patterns. These activities illustrate the relationship between repeated addition and multiplication, as well as patterns that appear when counting by 3s.
Learning Tasks Per Week (Including Instructional Strategies)

Week 1: Lesson One: During the first half of the session, students take the Unit 4 Pre-Assessment. When most students are finished with the assessment, the teacher reconvenes the class and conducts an activity in which students estimate and measure the distance across the classroom with their feet. In doing so, they discover that the distance varies, depending on whose feet one uses.



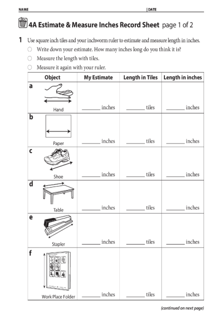


Mrs. Ramirez and Brandt

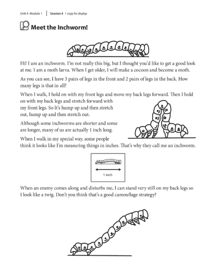
Teacher Feet Record Sheet

1 How long are some of the things around our classroom in teacher feet?

Things We Measured	Estimate	Actual Answer
the whiteboard ledge	10TF	8TF



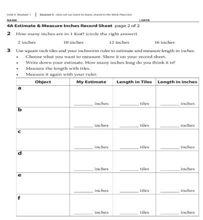
4A Estimate & Measure Inches Record Sheet page 1 of 2



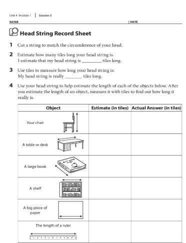
Meet the Inchworm!

Then they work in pairs to do some more measuring around the classroom with a standard sized foot—the teachers. Finally, the teacher introduces and assigns the Pencil Puppy & Pal Home Connection.

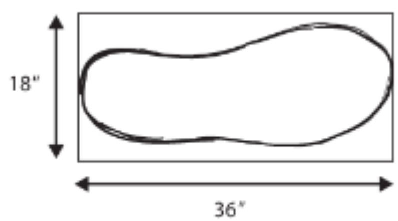
Lesson Two: After listening to the story of Jim and the Beanstalk, a variation on the classic Jack and the Beanstalk tale, students compare a teacher foot (12 inches) to a giant foot (1 yard). Students then work as a class to measure the distance across the room in giant feet and compare the measure to the same distance in teacher feet. Next, students work in pairs to create their own giant feet to measure various distances. At the end of the session, students go to Work Places.

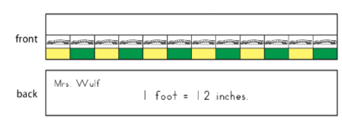


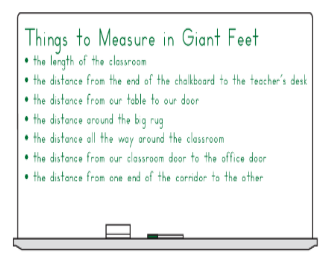
4A Estimate & Measure Inches Record Sheet page 2 of 2



Head String Record Sheet

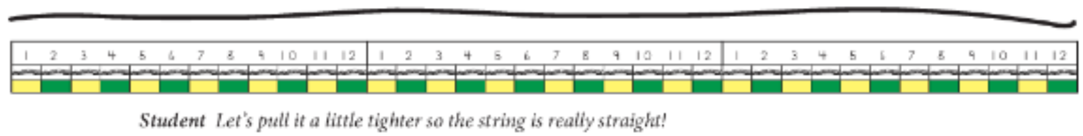




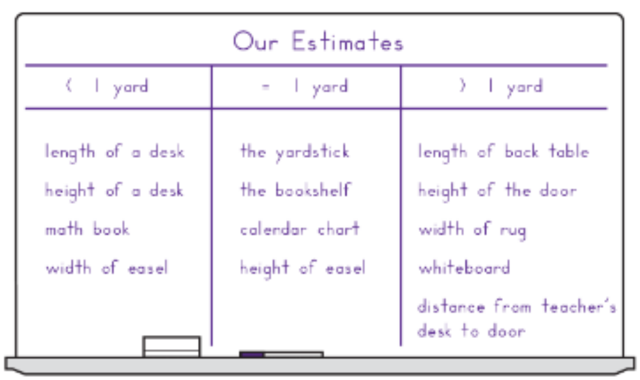


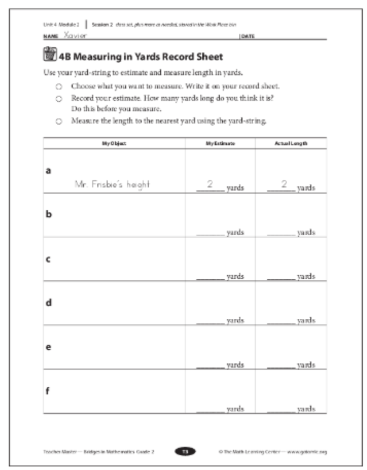
Week 2:

Lesson Six: From Feet to Yards Students estimate the length of a distance you've pre-marked in the corridor outside the classroom and then use their inchworm rulers to measure it in feet. When they return to the classroom, they discuss the yard unit of measure. They work in groups of three to cut yard-long lengths of string and then remeasure the distance in the hall, this time in yards instead of feet.



Lesson Seven: Measuring in Yards Students brainstorm a list of items around the classroom that are less than, equal to, and greater than a yard in length. Then pairs of students work to verify these measures and others as they complete an assignment in their Student Books. After this, the teacher introduces Work Place 4B Measuring in Yards, an activity in which students estimate and measure the length of various items to the nearest whole yard. Introducing Workplace 4B Measuring in Yards Students work in pairs to choose objects in and near the classroom to measure in yards. First, they find an object to measure and write the name of the object on their record sheets. Then they estimate the length of the object, and finally measure it to the nearest yard, using a yard-long piece of string.

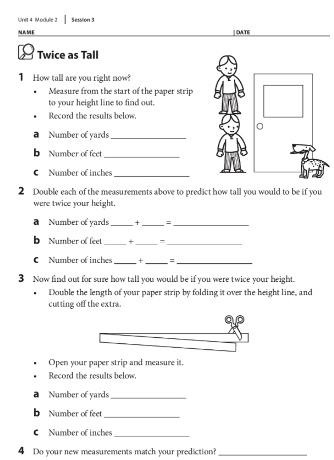



4B Measuring in Yards Record Sheet

Use your yard-string to estimate and measure length in yards.

- Choose what you want to measure. Write it on your record sheet.
- Record your estimate. How many yards long do you think it is? Do this before you measure.
- Measure the length to the nearest yard using the yard-string.

	My Object	My Estimate	Actual Length
a	Mr. Frisbie's height	2 yards	2 yards
b		yards	yards
c		yards	yards
d		yards	yards
e		yards	yards
f		yards	yards


Twice as Tall

1 How tall are you right now?
- Measure from the start of the paper strip to your height line to find out.
- Record the results below.

a Number of yards ____

b Number of feet ____

c Number of inches ____

2 Double each of the measurements above to predict how tall you would to be if you were twice your height.

a Number of yards ____ + ____ = ____

b Number of feet ____ + ____ = ____

c Number of inches ____ + ____ = ____

3 Now find out for sure how tall you would be if you were twice your height.
- Double the length of your paper strip by folding it over the height line, and cutting off the extra.
- Open your paper strip and measure it.
- Record the results below.

a Number of yards ____

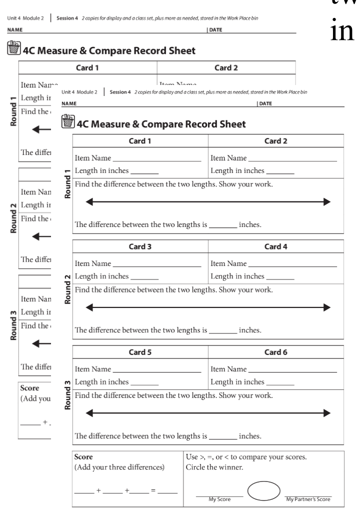
b Number of feet ____

c Number of inches ____

4 Do your new measurements match your prediction? ____

Lesson Eight: Twice as Tall The teacher invites students to think about how tall they would be if they were twice their current height. Then the teacher helps each student cut a strip of adding machine tape to more than double their height, and the students work in pairs to find out exactly how tall they are right now, and how tall they would be if they were twice as tall.

Lesson Nine: Introducing Work Place 4C Measure & Compare The teacher introduces and plays a new measurement game with the class. In Measure & Compare, players measure the lengths of the objects in inches. Each player finds the difference between two of the objects and after three rounds of play, calculates the sum of these differences. Players compare their sums and roll a more/ less die to determine the winner of the game. Introducing WorkPlace 4C Measure & Compare Two players each draw two cards. Each player then measures the pictured items on their two cards and finds the difference in the measures of the two items. Players repeat this for two more rounds. Then each player adds their differences to get an overall total score. A more/less die is rolled to determine a winner.

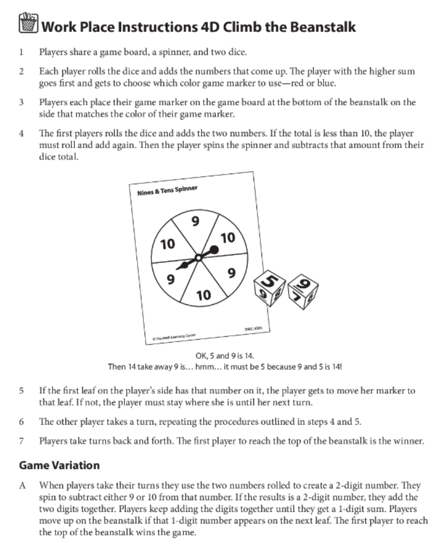


Unit 4 Module 2 | Session 4 2 copies for display and a class set, plus more as needed, stored in the Work Place bin

NAME | DATE

4C Measure & Compare Record Sheet

	Card 1	Card 2
Round 1	Item Name ______ Length in inches ______	Item Name ______ Length in inches ______
	Find the difference between the two lengths. Show your work. The difference between the two lengths is ______ inches.	
	Card 3	Card 4
Round 2	Item Name ______ Length in inches ______	Item Name ______ Length in inches ______
	Find the difference between the two lengths. Show your work. The difference between the two lengths is ______ inches.	
	Card 5	Card 6
Round 3	Item Name ______ Length in inches ______	Item Name ______ Length in inches ______
	Find the difference between the two lengths. Show your work. The difference between the two lengths is ______ inches.	
	Score (Add your three differences) ____ + ____ + ____ = ____	Use >, =, or < to compare your scores. Circle the winner. My Score / My Partner's Score



Work Place Instructions 4D Climb the Beanstalk

1 Players share a game board, a spinner, and two dice.

2 Each player rolls the dice and adds the numbers that come up. The player with the higher sum goes first and gets to choose which color game marker to use—red or blue.

3 Players each place their game marker on the game board at the bottom of the beanstalk on the side that matches the color of their game marker.

4 The first players rolls the dice and adds the two numbers. If the total is less than 10, the player must roll and add again. Then the player spins the spinner and subtracts that amount from their dice total.

Nines & Tens Spinner

OK, 5 and 9 is 14.
Then 14 take away 9 is… hmm… it must be 5 because 9 and 5 is 14!

5 If the first leaf on the player's side has that number on it, the player gets to move her marker to that leaf. If not, the player must stay where she is until her next turn.

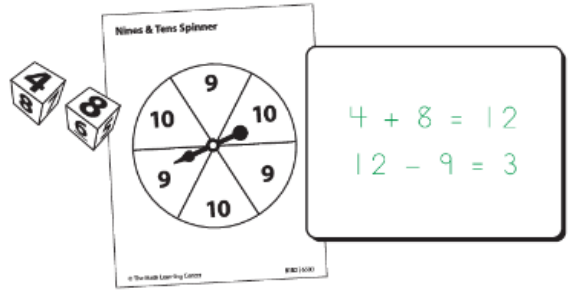
6 The other player takes a turn, repeating the procedures outlined in steps 4 and 5.

7 Players take turns back and forth. The first player to reach the top of the beanstalk is the winner.

Game Variation

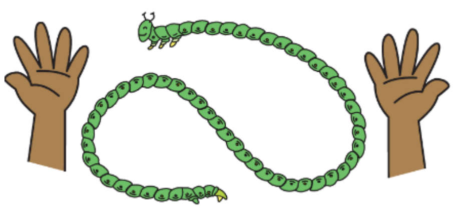
A When players take their turns they use the two numbers rolled to create a 2-digit number. They spin to subtract either 9 or 10 from that number. If the results is a 2-digit number, they add the two digits together. Players keep adding the digits together until they get a 1-digit sum. Players move up on the beanstalk if that 1-digit number appears on the next leaf. The first player to reach the top of the beanstalk wins the game.

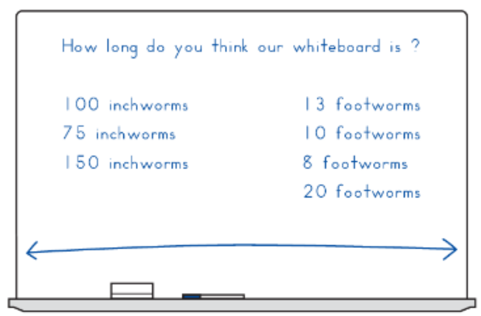
Lesson Ten: Inches, Feet & Yards Checkpoint Today the teacher introduces a new Workplace game (Climb the Beanstalk) that provides practice with addition and subtraction facts to 20. Students then take a short checkpoint assessment that looks at their current skills with measuring and comparing lengths in inches, feet, and yards. As they finish, students get their folders and go out to Work Places.

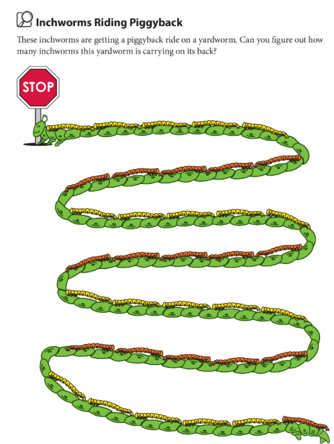


Week 3:

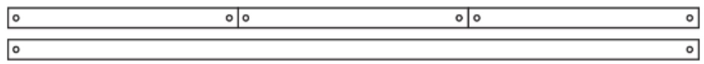
Lesson Eleven: Foot worms In this session, students investigate the effect of measuring the length of an object with different units– in this case, inches, and feet. Students compare units of measurement and explore how the size of the unit impacts the number of units necessary to measure the object.



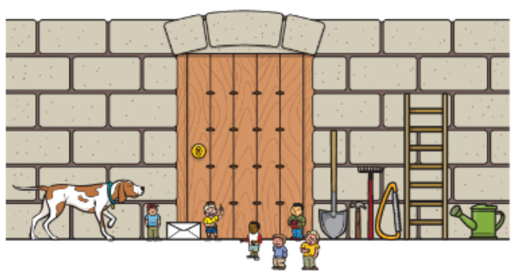


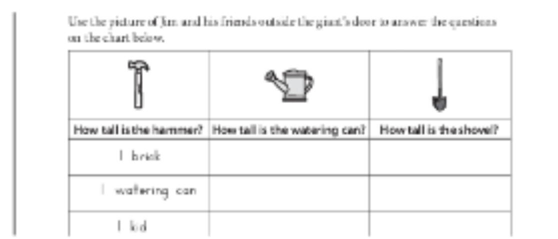


Lesson Twelve: Yard worms In this session, students consider three related units of measurement:yards, feet, and inches. Students compare units of measurement and explore how the size of the unit impacts the number of units necessary to measure the object.



Lesson Thirteen: Outside the Giant's Door This session opens with a new chapter in the story of Jim and the Beanstalk that sets the context for the next three sessions. Students then solve and discuss a series of problems related to measurement using non-standard units, based on a picture of Jim and his friends outside the giant's door. This activity lays the foundation for the kind of multiplicative comparison and proportional reasoning that will be expected in later grades.

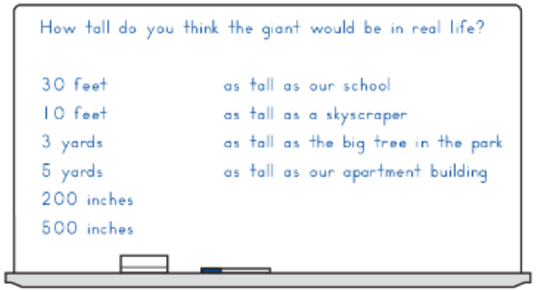


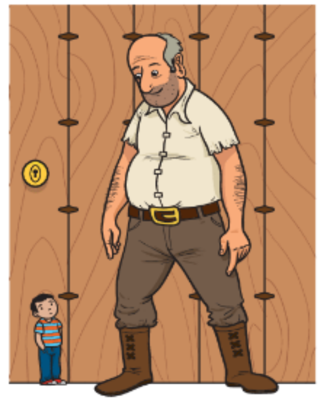


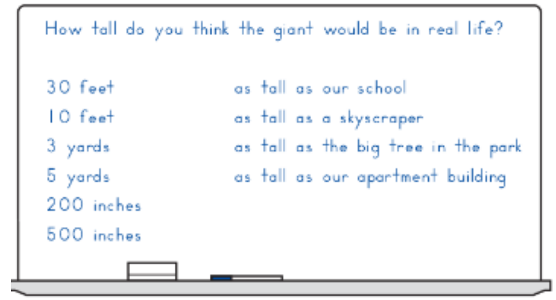
Use the picture of Jim and his friends outside the giant's door to answer the questions on the chart below.

How tall is the hammer?	How tall is the watering can?	How tall is the shovel?
1 brick		
1 watering can		
1 kid		

Lesson Fourteen: How Tall Is the Giant's Door? Students continue to solve problems related to measurement using nonstandard units, based on the picture of Jim and his friends outside the giant's door. This session continues to provide informal experiences with ratios and proportional reasoning and extends into basic fractional measurement.





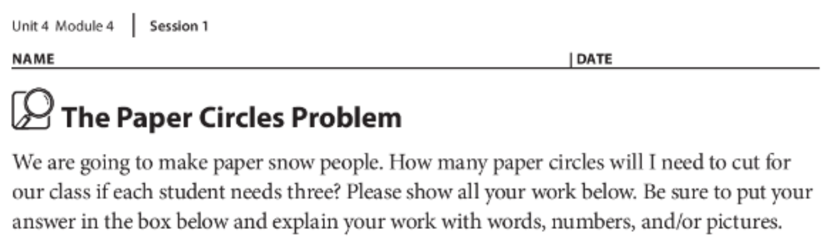


Lesson Fifteen: A Real-Life Giant In this session, students work with information given in two different pictures, to calculate the real-life height of the giant and some of the other objects outside the giant's door. After determining and discussing the giant's actual height, students complete a related assignment in their Student Books.

Week 4:

Lesson Sixteen: Unit 4 Post-Assessment Students complete the Unit 4 Post-Assessment today. As they finish and turn in their assessments, they get their folders and go out to Work Places.

Lesson Seventeen: The Paper Circles Problem This is the first of four sessions in which students move into the arena of multiplication through adding sets of three and exploring the number patterns that result. Snow people provide the context for this investigation.



Unit 4 Module 4 | Session 1

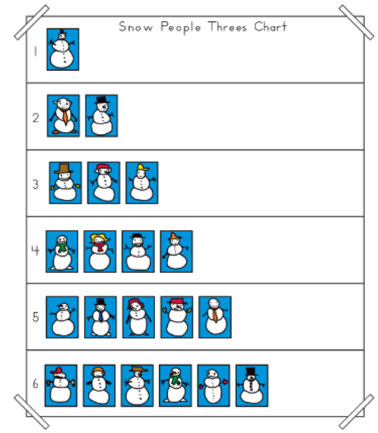
NAME | DATE

The Paper Circles Problem

We are going to make paper snow people. How many paper circles will I need to cut for our class if each student needs three? Please show all your work below. Be sure to put your answer in the box below and explain your work with words, numbers, and/or pictures.

Lesson Eighteen: Thinking About Threes In this session, students examine, discuss, and write equations to match a collection of dot arrays. Then they each make a snow person from three white circles. The snow people are added to a snow people chart that illustrates counting by 3s. If time allows, students go to Work Places after they finish their snow people.

Lesson Nineteen: The Snow People Threes Chart The teacher leads the class in labeling the Snow People Threes Chart from the previous session with addition and multiplication equations. Then students share and discuss mathematical observations about the chart. The teacher poses more questions about extending the pattern created and then students work independently to write their own observations on record sheets. These sheets may be saved as scored work samples.



Lesson Twenty: Patterns & Problems with Threes Students use the Snow People Threes Chart again to extend counting by 3s through 100 on a hundred grid. They then work individually to write observations about the resulting patterns found in their work and to solve problems related to counting by 3s. These sheets may be saved as scored work samples.

Interdisciplinary / Real World / Global Connections

- Students explore measurement from multiple entry points. Initial activities in the unit foster an understanding of the importance of standard units of measurement.
- This unit uses context (the giant's world) to introduce proportional reasoning in a manner that is intuitive to second grade students (e.g., "The giant's door is as tall as 5 bricks."). This will lay the important groundwork for the multiplicative comparison and proportional reasoning skills expected in later grades.
- The use of snow people allows students to think in threes building the connection between repeated addition and multiplication with the array model.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

Support:

- Ensure instructional materials are systematic and explicit. They should include numerous clear models of easy and difficult problems, with accompanying teacher think alouds.
- Provide students with opportunities to solve problems in a group and communicate problem-solving strategies.
- Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type.
- Students should work with visual representations of mathematical ideas.
- If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulations first. (Include the next line for middle school and older students only) Although this can also be done with students in upper elementary and middle school grades, use of manipulatives with older students should be expeditious because the goal is to move toward understanding of and facility with visual representations and finally to the abstract.
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution.
- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

Intervention for facts

- Provide about 10 minutes per session of instruction to build quick retrieval of basic arithmetic facts. Consider using technology, flashcards, and other materials for extensive practice to facilitate automatic retrieval.
- For students in K -2 explicitly teach strategies for efficient counting to improve the retrieval of mathematics facts.

MLL (Multilingual Learners)**:**

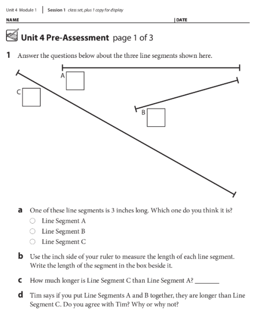
- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words.
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 4 Pre-Assessment - Module 1, Session 1


Unit 4 Module 1 | Session 1 *class set, plus 1 copy for display*

NAME | DATE

Unit 4 Pre-Assessment page 1 of 3

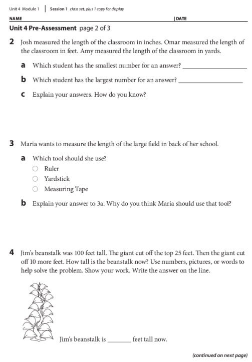
1 Answer the questions below about the three line segments shown here.

a One of these line segments is 3 inches long. Which one do you think it is?
- ○ Line Segment A
- ○ Line Segment B
- ○ Line Segment C

b Use the inch side of your ruler to measure the length of each line segment. Write the length of the segment in the box beside it.

c How much longer is Line Segment C than Line Segment A? _______

d Tim says if you put Line Segments A and B together, they are longer than Line Segment C. Do you agree with Tim? Why or why not?


Unit 4 Module 1 | Session 1 *class set, plus 1 copy for display*

NAME | DATE

Unit 4 Pre-Assessment page 2 of 3

2 Josh measured the length of the classroom in inches. Omar measured the length of the classroom in feet. Amy measured the length of the classroom in yards.

a Which student has the smallest number for an answer? ________________

b Which student has the largest number for an answer? ________________

c Explain your answers. How do you know?

3 Maria wants to measure the length of the large field in back of her school.

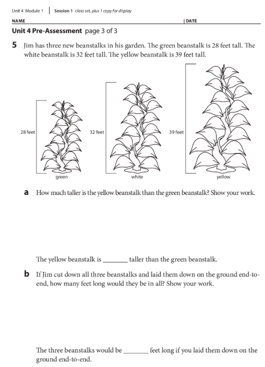
a Which tool should she use?
- ○ Ruler
- ○ Yardstick
- ○ Measuring Tape

b Explain your answer to 3a. Why do you think Maria should use that tool?

4 Jim's beanstalk was 100 feet tall. The giant cut off the top 25 feet. Then the giant cut off 10 more feet. How tall is the beanstalk now? Use numbers, pictures, or words to help solve the problem. Show your work. Write the answer on the line.

Jim's beanstalk is _______ feet tall now.

(continued on next page)


Unit 4 Module 1 | Session 1 *class set, plus 1 copy for display*

NAME | DATE

Unit 4 Pre-Assessment page 3 of 3

5 Jim has three new beanstalks in his garden. The green beanstalk is 28 feet tall. The white beanstalk is 32 feet tall. The yellow beanstalk is 39 feet tall.

a How much taller is the yellow beanstalk than the green beanstalk? Show your work.

The yellow beanstalk is _______ taller than the green beanstalk.

b If Jim cut down all three beanstalks and laid them down on the ground end-to-end, how many feet long would they be in all? Show your work.

The three beanstalks would be _______ feet long if you laid them down on the ground end-to-end.

Work Places:

- Estimate and Measure Inches
- Measuring in Yards
- Measure and Compare
- Climb the Beanstalk

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Inches, Feet, Yards Checkpoint
- Unit 4 Post Assessment

Unit 4 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Estimate length in inches. *line segment B*	2.MD.3	**1 pt.**	
1b Measure three line segments to the nearest whole inch. *A = 5 inches; B = 3 inches; C = 7 inches*	2.MD.1	**3 pts.** • 1 pt. for each correct answer	
1c Compare the length of two different line segments. *C is 2" longer than A.*	2.MD.4	**1 pt.**	
1d Compare the length of Segment A + Segment B to Segment C. *Yes. Explanations will vary. Sample: If you put A and B together, you get 8 inches. C is 7 inches, so it's shorter.*	2.MD.4 2.MD.5	**2 pts.** • 1 pt. for correct answer (Yes) • 1 pt. for an explanation that makes reference to the information in the problem.	
2a Understand that if you measure a length in different units, the largest unit will yield the smallest answer. *Amy*	2.MD.2	**1 pt.**	
2b Understand that if you measure a length in different units, the smallest unit will yield the largest answer. *Josh*	2.MD.2	**1 pt.**	
2c Explain answers to 2a and 2b. *Responses will vary. Example: Inches are small so it takes a lot of them. Yards are bigger, so it doesn't take as many.*	2.MD.2	**1 pt.** for an explanation that makes reference to the size of different units	
3a Select most appropriate tool to measure a field. *measuring tape; yardstick is also acceptable*	2.MD.1	**1 pt.**	
3b Explain answer to 3a. *Explanations will vary. Example: The field is big, and the tape is the longest tool.*	2.MD.1	**1 pt.** for an explanation that makes reference to either the size of the field, the length of the tool, or both	
		Subtotal page 1	

Inches, Feet & Yards Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Identify the best tool to measure a pencil. *inchworm ruler*	2.MD.1	**1 pt.**	
1b Justify choice for 1a. *Responses will vary. Example: The ruler is best because the pencil is short.*	2.MD.1	**1 pt.** for any explanation that makes reference to the length of the object or the length of the unit or tool	
2a Identify the best tool to measure a soccer field *measuring tape; yardstick is also acceptable*	2.MD.1	**1 pt.**	
2b Justify choice for 2a. *Responses will vary. Example: The measuring tape because the soccer field is very big.*	2.MD.1	**1 pt.** for any explanation that makes reference to the length of the object or the length of the unit or tool	
3a Choose the measurement Jeff most likely got when he measured a table in the classroom. *5 feet*	2.MD.3	**1 pt.**	
3b Justify choice for 3a. *Responses will vary. Example: It has to be 5 feet because 5 inches is too small for a table and 5 yards is too long.*	2.MD.3	**1 pt.** for a viable explanation	
4a Estimate length to choose the path that looks shorter. *Path A*	2.MD.3	**1 pt.**	
4b Measure each path in inches. *Path A is 5 inches long; Path B is 7 inches long*	2.MD.1	**2 pts.,** 1 for each correct measurement	
4c Identify the difference between two lengths, both given in inches. *Path A is 2 inches shorter than Path B.*	2.MD.4	**1 pt.**	
5 Understand that 24 inches and 2 feet are equivalent lengths. *Agrees with Sara; explanations will vary. Example: They are the same—there are 12 inches in a foot, and 12 + 12 = 24*	2.MD.2	**2 pts.** • 1 pt. for agreeing with Sara • 1 pt. for a viable explanation	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**12 pts.**	

* **Meeting Standard** 9–12 points (75%–100% correct) **Approaching Standard** 6–8 points (50–74% correct) **Strategic** 3–5 points (25–49% correct) **Intensive** 2 points or less (

Unit 4 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
4 Solve a story problem involving subtraction of length. Show work. *65 feet tall*	2.OA.1 2.MD.5	**2 pts.** • 1 pt. for using a procedure that could lead to the correct answer • 1 pt. for the correct answer	
5a Solve a story problem involving length comparison. Show work. *Yellow beanstalk is 11 feet taller.*	2.OA.1 2.MD.5	**2 pts.** • 1 pt. for using a procedure that could lead to the correct answer • 1 pt. for the correct answer	
5b Solve a story problem involving addition of 3 lengths. Show work. *99 feet*	2.OA.1 2.NBT.6 2.MD.5	**2 pts.** • 1 pt. for using a procedure that could lead to the correct answer • 1 pt. for the correct answer	
6a Use proportional reasoning to determine the height of two dogs in envelopes. *Two dogs are 3 envelopes tall; students' work will vary.*	2.MP.2 2.MP.7	**2 pts.** • 1 pt. for the correct answer • 1 pt. for showing work and using a viable strategy that could lead to the correct answer	
6b Use proportional reasoning to determine the height of the Giant in dogs. *The giant is 4 dogs tall.*	2.MP.2 2.MP.7	**2 pts.** • 1 pt. for the correct answer • 1 pt. for showing work and using a viable strategy that could lead to the correct answer	
6c Use proportional reasoning to determine the height of the Giant in envelopes. *The giant is 6 envelopes tall.*	2.MP.2 2.MP.7	**2 pts.** • 1 pt. for the correct answer • 1 pt. for showing work and using a viable strategy that could lead to the correct answer	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**24 pts.**	

* **Meeting Standard** 18–24 points (75%–100% correct) **Approaching Standard** 12–17 points (50–74% correct) **Strategic** 6–11 points (25–49% correct) **Intense** 5 points or less (

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 5: Place Value to One Thousand
Pacing	5 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
2.OA.C.3- Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.
2.NBT.A.1- Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals

7 hundreds, 0 tens, and 6 ones. 2.NBT.A.1.A 100 can be thought of as a bundle of ten tens — called a "hundred."
2.NBT.A.1.B The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones).
2.NBT.A.2- Count within 1000; skip-count by 5s, 10s, and 100s.
2.NBT.A.3- Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.
2.NBT.A.4- Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons.
2.NBT.B.7- Add and subtract within 1000, using concrete models or drawings and strategies based on
place value, properties of operations, and/or the relationship between addition and subtraction.
relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers,
one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is
necessary to compose or decompose tens or hundreds.
2.NBT.B.8- Mentally add 10 or 100 to a given number 100-900, and mentally subtract 10 or 100 from a given number 100-900.

Supporting Standards:
2.MD.A.4- Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard-length unit.
2.MD.B.5- Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.
2.MD.B.6- Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram.
2.MD.C.8- Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. Example: if you have 2 dimes and 3 pennies, how many cents do you have?
2.MD.D..10- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*

• Determine whether a group of objects is odd or even by pairing objects and counting by 2s.	• A number is even if it can be divided by two without a remainder, otherwise the number is odd.
• Understand that three digits of a three-digit number represent amounts of hundreds, tens, and ones.	• Three digits of a three-digit number represents amounts of hundreds, tens, and ones.
• Understanding 100 can be thought of as a bundle of ten tens.	• Numbers can be composed and decomposed in many ways.
• Understand 100, 200, 300, 400, 500, 600, 700, 800, 900 as a hundred with 0 tens and 0 ones.	• When a three-digit number has a zero is the digit in the tens and ones place, there are some exact numbers of hundreds.
• Understand adding or subtracting three-digit numbers, one adds and subtracts hundreds to/from hundreds, tens to/from tens, and ones to/from ones.	• When combining or separating numbers, the digits' place values must be determined and grouped with like place values.
• Understand it is sometimes necessary to compose and decompose when adding or subtracting multi-digit numbers.	• Breaking apart numbers in flexible ways allows for more efficient mental calculations.
• Count within 1000, by 5s, 10s, and 100s.	• The rote counting sequence patterns through 100 are repeated as numbers become larger.
• Read and write numbers to 1000.	• 3-digit numbers are made of hundreds, tens, and ones.
• Compare two three-digit numbers using >, =, <	• The symbols >, < and = are used to explain a number's magnitude in comparison to another.
• Add and subtract within 1000 using concrete models and strategies.	• Numbers can be represented with concrete or pictorial models in order to support calculations of larger numbers.
• Relate strategies to write a method of computation.	• Algorithms and mental strategies or strategies based on place value are related and can be repeated based on a

	certain set of procedures.
● Mentally add or subtract 10 or 100 from a given number 100 - 900.	● When adding/subtracting 10 or 100 to any number, only the digit in the tens or hundreds place changes, unless crossing a decade or hundred.
● Measure to determine how much longer one object is than another.	● You can find the difference in length by subtracting the shorter length from the longer.
● Express length difference in terms of standard length units.	● Things can be measured using standard or non-standard units as long as the units are the same size.
● Use addition and subtraction within 100 to solve word problems involving lengths.	● Measurement is a real-world application of addition and subtraction situations.
● Represent whole numbers as lengths from 0 on a number line with equally spaced points.	● A numberline is a length model that can be used to locate specific numbers in relation to others.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How does the place value system work?	1. A place value system is one in which the position of a digit in a number determines its value. In the standard system, called base ten, each place represents ten times the value of the place to its right. You can think of this as making groups of ten of the smaller units and combining them to make a new unit.
2. How does understanding place value help us to compare, order, and compute whole numbers?	2. Place value is the basis for our entire base ten number system and important to all mathematics. Understanding the meaning of place value and its appropriate use promotes accurate understanding of the position of digits,

3. How do we measure money?	their value and how to manipulate them appropriately for accurate and efficient computation. 3. Money is measured in standard units of cents and dollars. The increments are made up of pennies, nickels, dimes, quarters, dollars, five dollars, ten dollars, etc.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

Standard 1.5.C: Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Books/Media:

Informational text:
- Great Estimations

Media:
- Even Number Song
- Odd Number Song

Children's Literature:
- Zero the Hero, Juan Holub
- Earth Day - Hooray, Lisa Bullard
- The Power of 10, Judy Newhoff
- Sir Cumference and All the King's Tens , Cindy Neuschwander
- The King's Commissioners, Aileen Friedman

Online Resources / Websites:
- MLC Number Pieces App
- MLC Money Pieces App

- MLC Number Line App
- MLC Pattern Shapes App
- Coin Box

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Decimal point:** a point or dot we use to separate the whole number part from the fractional part of a decimal number. **Cent (¢):** equal to one hundredth of the base currency unit. **Equation:** a mathematical statement that is made up of two expressions connected by an equal sign. **Compare:** to examine in order to note similarities and differences; to determine whether numbers are greater than, less than or equal to each other. **Even:** a number which is divisible by 2 and generates a remainder of 0 is called an even number. **Digit:** A single symbol used to make a numeral. **Hundred(s):** the position containing a digit representing that number followed by two zeros. **Dime:** a ten-cent coin. **Odd number:** An odd number is a number which is not divisible by 2. The remainder in the case of an odd number is always "1". **Distance:** Length. A measurement of how far through space. **Ones:** the numbers 0 through 9; also refers to the ones place. **Dollar:** One dollar equals 100 cents. **Equal:** having the same value, measure, or amount as something else. **Greater than:** a symbol used to indicate that the number on the left is greater than the number on the right. **Growing pattern:** a pattern that gets bigger; the numbers or shapes increase. **Height:** how tall something is; the measurement from top to bottom of an object or a shape. **Length:** how long something is. **Less than:** a symbol used to indicate that the number on the left is less than the number on the right. **Measurement:** a number that shows the size or amount of something. **Nickel:** a five cent coin. **Pattern:** repeated design or recurring sequence. **Penny:** a one cent coin. **Quarter:** a twenty-five cent coin.

Repeating pattern: a pattern where the same terms repeat over and over.
Sequence: A list of numbers or objects in a special order. Example: 3, 5, 7, 9, ... is a sequence starting at 3 and increasing by 2 each time
Weight: the measure of the force of gravity on an object.

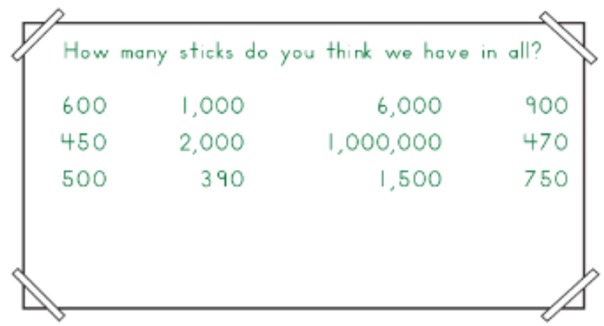
Learning Plan

Overview and Key Learning Events and Instruction Per Week

Unit 5 is designed to help students solidify their understanding of place value to 1,000. Using a variety of manipulatives, students create and count bundles (or groups) in 10s and 100s. They practice adding and subtracting in multiples of 10 and 100, both on and off the decade. The sessions that focus explicitly on money contexts provide opportunities for students to count by 5 and 10 and consider 25 cents or a quarter as a unit. The final module in the unit is algebraic in nature, encouraging students to observe and describe sequences as they search for patterns and generalizations that will enable them to build and represent succeeding arrangements in those sequences.

Learning Tasks Per Week (Including Instructional Strategies)

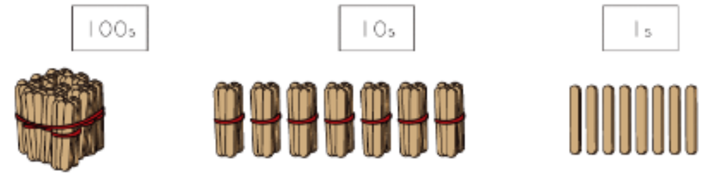
Week One:



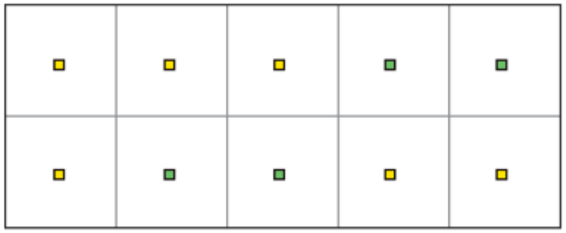
Lesson One: Introducing One Thousand
To open this unit, students each write and share one thing they already know about 1,000. The teacher then reads How Much, How Many, How Far, How Heavy, How Long, How Tall Is 1,000? by Helen Nolan. Next, the students take a unit pre assessment, and then go out to Work Places as they finish their assessments.

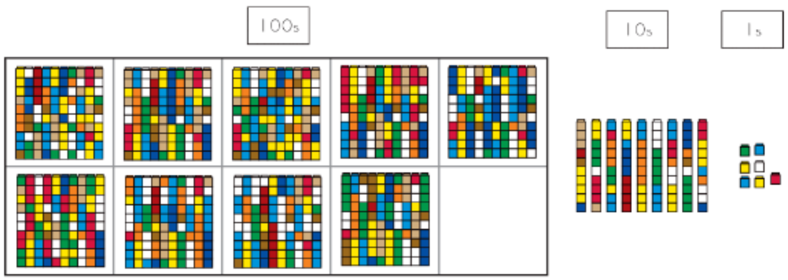
Lesson Two: Pick-Up Sticks

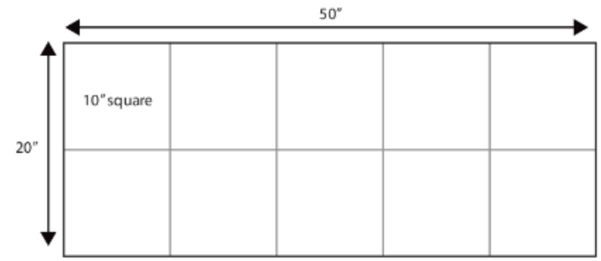
In this session students build place value understandings to 1,000 as they work together to count many craft sticks. After estimating the total number of craft sticks in six containers, students work in groups to count the sticks and bundle them into 10s and 100s. They then come together to record, compare, and order the number of sticks in each container. Finally, they find the total number of sticks and compare it to their original estimates.



Lesson Three: One Thousand Cubes?
To open the session, students work together to revisit the base ten area pieces, reviewing the fact that there are 10 units in a ten-strip, and 10 ten-strips or 100 units in a mat. Then they arrange and count 10 hundred pieces (mats) to discover that there are 1,000 units in 10 mats. After this review, students work first in small groups, and then as a whole class, to find out whether they still have the number of Unifix cubes that came with the original set: 1,000.

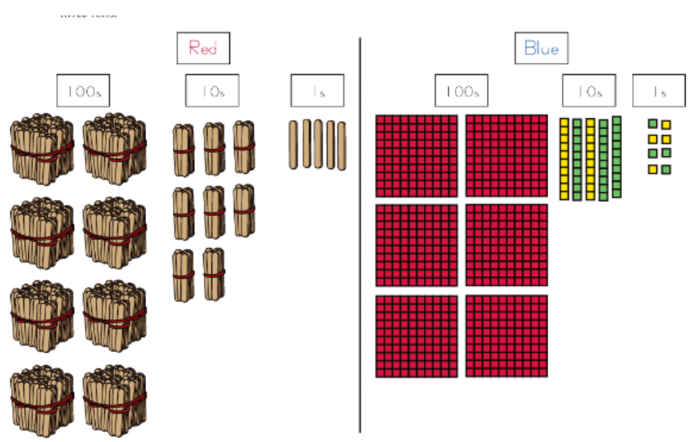


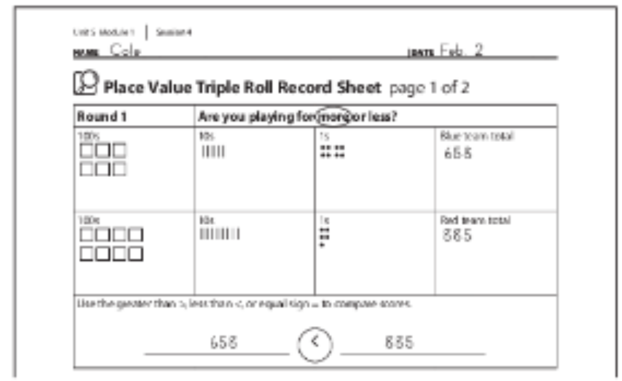




Lesson Four: Place Value Triple Roll

In this session, the class plays a variation of the Work Place game Base Ten Triple Spin, in which they build, record, compare, and order numbers to 999. In this version of the game, students build numbers using the bundles of craft sticks created in a previous session, as well as base ten area pieces.





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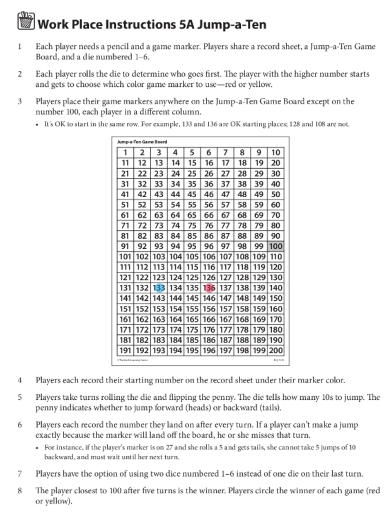
Place Value Triple Roll Record Sheet page 1 of 2

Round 1	Are you playing for more or less?		
100s	10s	1s	Blue team total 658
100s	10s	1s	Red team total 585

Use the greater than >, less than <, or equal sign = to compare scores.

658 < 585



Work Place Instructions 5A Jump-a-Ten

1 Each player needs a pencil and a game marker. Players share a record sheet, a Jump-a-Ten Game Board, and a die numbered 1–6.

2 Each player rolls the die to determine who goes first. The player with the higher number starts and gets to choose which color game marker to use—red or yellow.

3 Players place their game markers anywhere on the Jump-a-Ten Game Board except on the number 100, each player in a different column.

- It's OK to start in the same row. For example, 133 and 136 are OK starting places; 128 and 108 are not.

Jump-a-Ten Game Board

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

4 Players each record their starting number on the record sheet under their marker color.

5 Players take turns rolling the die and flipping the penny. The die tells how many 10s to jump. The penny indicates whether to jump forward (heads) or backward (tails).

6 Players each record the number they land on after every turn. If a player can't make a jump exactly because the marker will land off the board, he or she misses that turn.

- For instance, if the player's marker is on 27 and she rolls a 5 and gets tails, she cannot take 5 jumps of 10 backward, and must wait until her next turn.

7 Players have the option of using two dice numbered 1–6 instead of one die on their last turn.

8 The player closest to 100 after five turns is the winner. Players circle the winner of each game (red or yellow).

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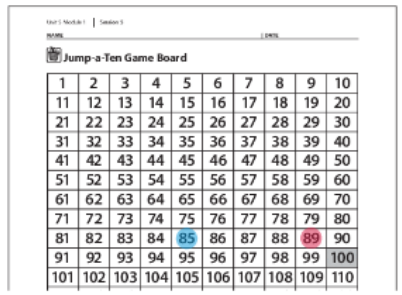
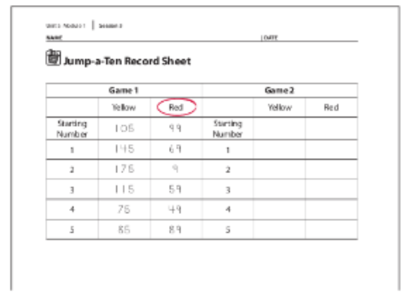
Lesson Five: Introducing Work Place 5A Jump-a-Ten
After a short counting warm-up, the teacher introduces a new Work Place game that provides practice with adding and subtracting 10s from numbers between 1 and 200. Students then take a checkpoint assessment that looks at their current skills with place value counting and computation. Introducing Work Place 5A Jump-a-Ten Each player sets a marker anywhere on a game board with numbers from 1–200 except on 100. Each player must choose a different column, but they may start in the same row. Players take turns rolling a die to see how many 10s to move, and flipping a penny to see whether to move forward (heads) or backward (tails). The player whose game marker lands closest to 100 (either under or over) after five turns wins the game.

Work Place Instructions 5A Jump-a-Ten



Jump-a-Ten Game Board

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110



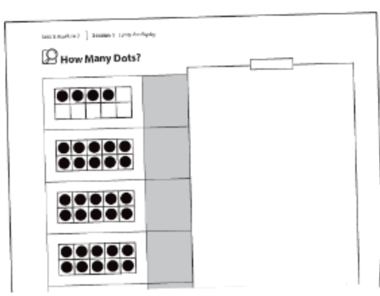
Jump-a-Ten Record Sheet

Game 1			Game 2		
	Yellow	Red		Yellow	Red
Starting Number	105	99	Starting Number		
1	145	69	1		
2	175	9	2		
3	115	59	3		
4	75	49	4		
5	85	89	5		

I won because 89 is only 11 away from 100, and 85 is 15 away from 100.
I was worried that I might lose a turn when I got down to 9, but the penny landed on heads, so I got to move up.

Week Two:

Lesson Six: Two Dimes & a Nickel
This session starts with a warm-up in which students practice counting forward and backward off the decade by 10s. Then the teacher reviews 5-frame and 10-frame models and connects them to money. Next, the teacher introduces the 25-frame as a model for students to structure 25¢ as a composite unit. The class uses the 25-frame to solve some problems together, and then students complete a related assignment in their student books.

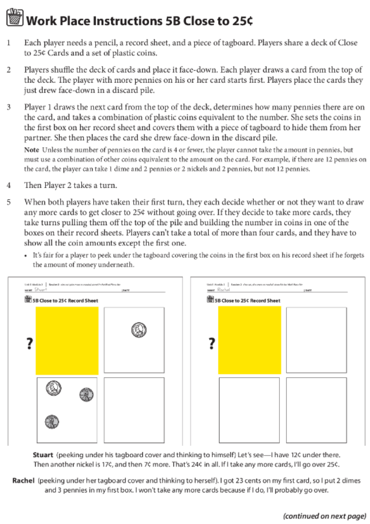


5A Jump-a-Ten Game Board

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110

Lesson Seven: Introducing Work Place 5B Close to 25¢

This session starts with a warm-up in which students practice counting forward by 5s from 23 to 113, and back. Then the teacher teaches the class how to play a new Work Place game. Close to 25¢ uses the 25-frames introduced last session and provides lots of opportunities to count and add sets of mixed coins. Introducing Work Place 5B Close to 25¢ Players take turns drawing cards from a deck and building with coins the amount on each card they draw. Players try to collect a total as close as possible to 25¢ without going over that amount. The player who gets closest to 25¢ without going over wins the round.



Work Place Instructions 5B Close to 25¢

1 Each player needs a pencil, a record sheet, and a piece of tagboard. Players share a deck of Close to 25¢ Cards and a set of plastic coins.

2 Players shuffle the deck of cards and place it face-down. Each player draws a card from the top of the deck. The player with more pennies on his or her card starts first. Players place the cards they just drew face-down in a discard pile.

3 Player 1 draws the next card from the top of the deck, determines how many pennies there are on the card, and takes a combination of plastic coins equivalent to the number. She sets the coins in the first box on her record sheet and covers them with a piece of tagboard to hide them from her partner. She then places the card she drew face-down in the discard pile.

Note Unless the number of pennies on the card is 4 or fewer, the player cannot take the amount in pennies, but must use a combination of other coins equivalent to the amount on the card. For example, if there are 12 pennies on the card, the player can take 1 dime and 2 pennies or 2 nickels and 2 pennies, but not 12 pennies.

4 Then Player 2 takes a turn.

5 When both players have taken their first turn, they each decide whether or not they want to draw any more cards to get closer to 25¢ without going over. If they decide to take more cards, they take turns pulling them off the top of the pile and building the number in coins in one of the boxes on their record sheets. Players can't take a total of more than four cards, and they have to show all the coin amounts except the first one.

- It's fair for a player to peek under the tagboard covering the coins in the first box on his record sheet if he forgets the amount of money underneath.

Stuart

5B Close to 25¢ Record Sheet

?

Rachel

5B Close to 25¢ Record Sheet

?

Stuart (peeking under his tagboard cover and thinking to himself) Let's see—I have 12¢ under there. Then another nickel is 17¢, and then 7¢ more. That's 24¢ in all. If I take any more cards, I'll go over 25¢.

Rachel (peeking under her tagboard cover and thinking to herself). I got 23 cents on my first card, so I put 2 dimes and 3 pennies in my first box. I won't take any more cards because if I do, I'll probably go over.

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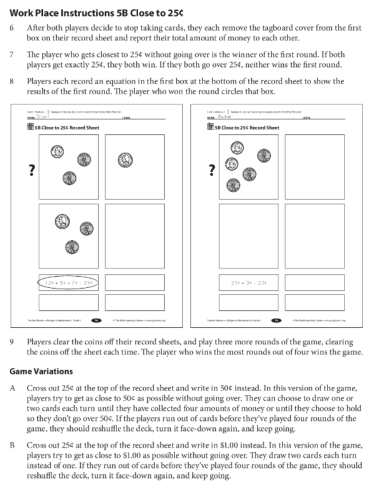


Work Place Instructions 5B Close to 25¢

6 After both players decide to stop taking cards, they each remove the tagboard cover from the first box on their record sheet and report their total amount of money to each other.

7 The player who gets closest to 25¢ without going over is the winner of the first round. If both players get exactly 25¢, they both win. If they both go over 25¢, neither wins the first round.

8 Players each record an equation in the first box at the bottom of the record sheet to show the results of the first round. The player who won the round circles that box.

Stuart

5B Close to 25¢ Record Sheet

?

12¢ + 5¢ + 7¢ = 24¢

Rachel

5B Close to 25¢ Record Sheet

?

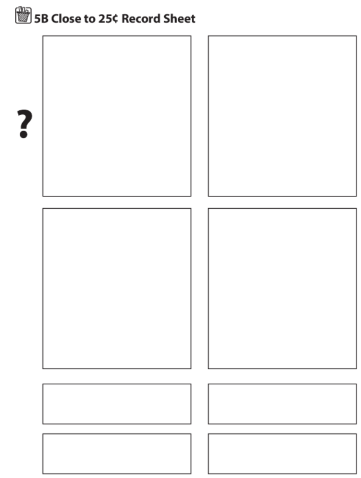
23¢ + 0¢ = 23¢

9 Players clear the coins off their record sheets, and play three more rounds of the game, clearing the coins off the sheet each time. The player who wins the most rounds out of four wins the game.

Game Variations

A Cross out 25¢ at the top of the record sheet and write in 50¢ instead. In this version of the game, players try to get as close to 50¢ as possible without going over. They can choose to draw one or two cards each turn until they have collected four amounts of money or until they choose to hold so they don't go over 50¢. If the players run out of cards before they've played four rounds of the game, they should reshuffle the deck, turn it face-down again, and keep going.

B Cross out 25¢ at the top of the record sheet and write in $1.00 instead. In this version of the game, players try to get as close to $1.00 as possible without going over. They draw two cards each turn instead of one. If they run out of cards before they've played four rounds of the game, they should reshuffle the deck, turn it face-down again, and keep going.

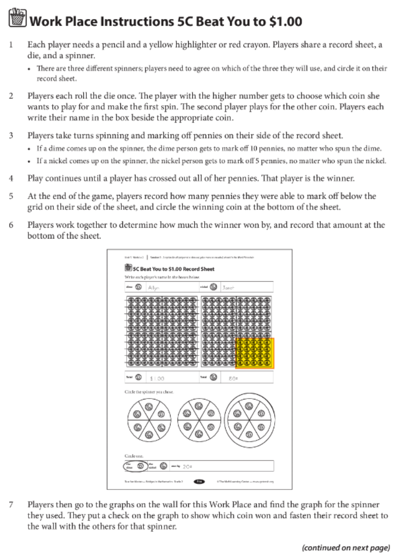


5B Close to 25¢ Record Sheet

?

Lesson Eight: Introducing Work Place 5C Beat You to $1.00

Students are divided into two teams to play a game called Beat You to $1.00, which will become a new Work Place. After playing the game two or three times as a class, students go out to Work Places, including the new one. Introducing Work Place 5C Beat You to $1.00 Players choose which coin they want to play for—a nickel or a dime—and agree on one of three spinners to use. Each spinner has a different combination of dimes and nickels, one of which appears to be more fair than the others. After each spin, the player playing for the coin the spinner lands on gets to cross out that amount of pennies off her own grid. The winner is the first player to cross out all 100 pennies.



Work Place Instructions 5C Beat You to $1.00

1 Each player needs a pencil and a yellow highlighter or red crayon. Players share a record sheet, a die, and a spinner.

- There are three different spinners; players need to agree on which of the three they will use, and circle it on their record sheet.

2 Players each roll the die once. The player with the higher number gets to choose which coin she wants to play for and make the first spin. The second player plays for the other coin. Players each write their name in the box beside the appropriate coin.

3 Players take turns spinning and marking off pennies on their side of the record sheet.

- If a dime comes up on the spinner, the dime person gets to mark off 10 pennies, no matter who spun the dime.
- If a nickel comes up on the spinner, the nickel person gets to mark off 5 pennies, no matter who spun the nickel.

4 Play continues until a player has crossed out all of her pennies. That player is the winner.

5 At the end of the game, players record how many pennies they were able to mark off below the grid on their side of the sheet, and circle the winning coin at the bottom of the sheet.

6 Players work together to determine how much the winner won by, and record that amount at the bottom of the sheet.

7 Players then go to the graphs on the wall for this Work Place and find the graph for the spinner they used. They put a check on the graph to show which coin won and fasten their record sheet to the wall with the others for that spinner.

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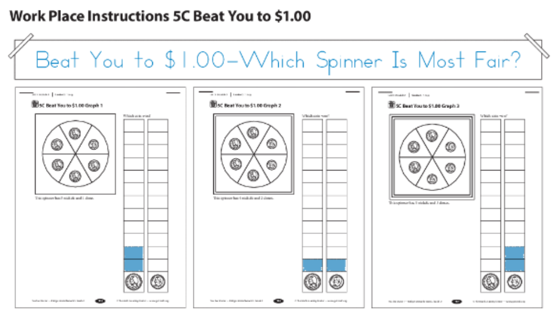
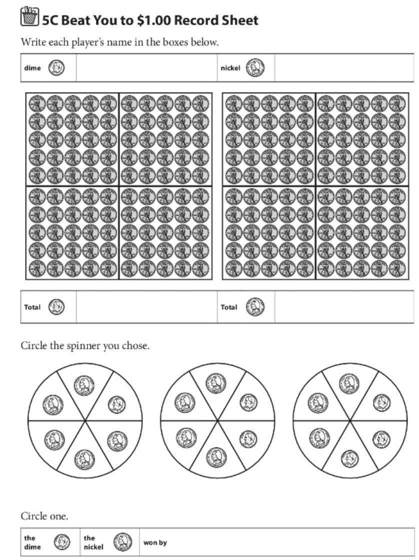




5C Beat You to $1.00 Record Sheet

Write each player's name in the boxes below.

dime		nickel	
Total		Total	

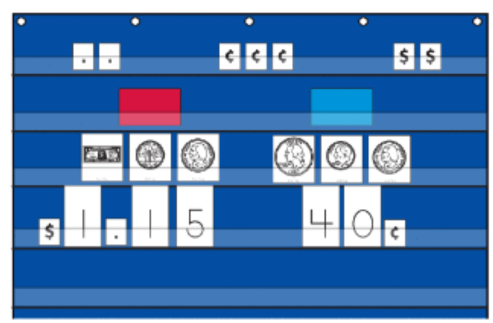
Circle the spinner you chose.

Circle one.

the dime	the nickel	won by

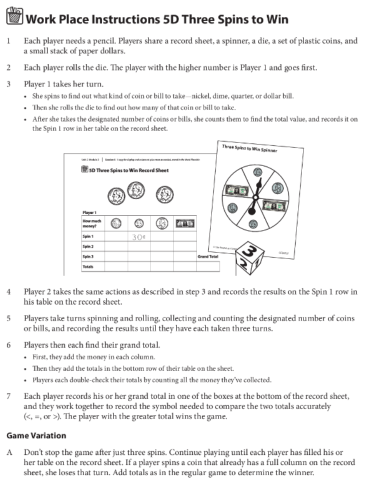
Lesson Nine: Pocketful of Coins
This session begins with practice counting by 5s and 10s, forward and backward, from numbers that don't end in 0 or 5. Then the teacher shows collections of coins for a couple of seconds each, and has students share what they see (how many and what kind of coins, and the value of the collection). Next, students start a written assignment in their Student Books together, and then complete the rest on their own.

Lesson Ten: Dollars & Cents
In this session, the class plays a game that provides practice in identifying coins, totaling the values of coins less than a dollar, and using cent and dollar symbols, as well as the decimal point, to label different amounts of money.



Week Three:

Lesson Eleven: Introducing Work Place 5D Three Spins to Win
Today the teacher introduces a new Work Place game that provides more practice with counting and adding sums of money. Students then take a checkpoint assessment that looks at their current skills with money. Introducing Work Place 5D Three Spins to Win Players take turns spinning a spinner to determine what kind of bill or coin to take, and then rolling a die to determine how many of that coin or bill they get. Players each take three turns to spin, roll, count, and record. Then they each add their amounts to find a grand total, and compare their totals to determine the winner.



Work Place Instructions 5D Three Spins to Win

1 Each player needs a pencil. Players share a record sheet, a spinner, a die, a set of plastic coins, and a small stack of paper dollars.

2 Each player rolls the die. The player with the higher number is Player 1 and goes first.

3 Player 1 takes her turn.
- She spins to find out what kind of coin or bill to take—nickel, dime, quarter, or dollar bill.
- Then she rolls the die to find out how many of that coin or bill to take.
- After she takes the designated number of coins or bills, she counts them to find the total value, and records it on the Spin 1 row in her table on the record sheet.

4 Player 2 takes the same actions as described in step 3 and records the results on the Spin 1 row in his table on the record sheet.

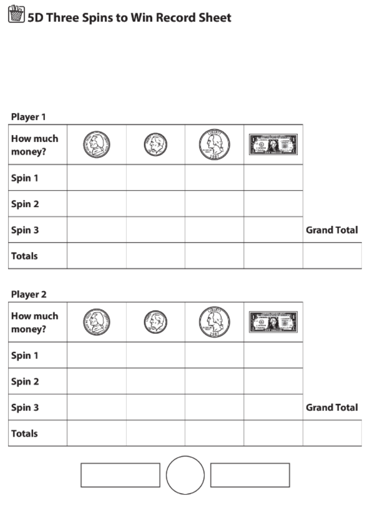
5 Players take turns spinning and rolling, collecting and counting the designated number of coins or bills, and recording the results until they have each taken three turns.

6 Players then each find their grand total.
- First, they add the money in each column.
- Then they add the totals in the bottom row of their table on the sheet.
- Players each double-check their totals by counting all the money they've collected.

7 Each player records his or her grand total in one of the boxes at the bottom of the record sheet, and they work together to record the symbol needed to compare the two totals accurately (<, =, or >). The player with the greater total wins the game.

Game Variation

A Don't stop the game after just three spins. Continue playing until each player has filled his or her table on the record sheet. If a player spins a coin that already has a full column on the record sheet, she loses that turn. Add totals as in the regular game to determine the winner.



5D Three Spins to Win Record Sheet

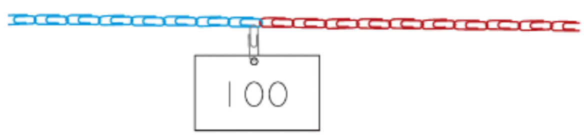
Player 1

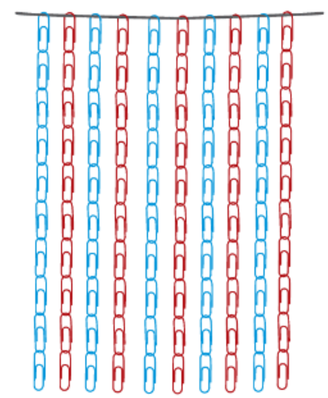
How much money?					
Spin 1					
Spin 2					
Spin 3					Grand Total
Totals					

Player 2

How much money?					
Spin 1					
Spin 2					
Spin 3					Grand Total
Totals					

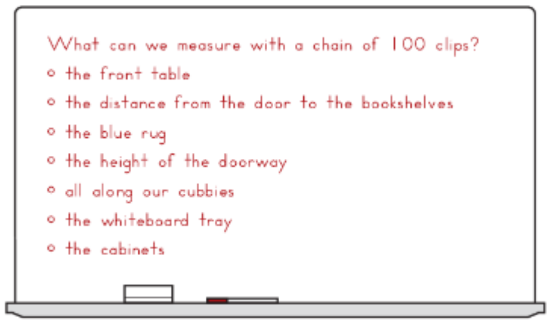
Lesson Twelve: One Thousand Clips
During this session, students work together to make a chain of 1,000 clips, investigating multiples of 10 and multiples of 100 as they create sections of 10, then sections of 100, and finally one long chain. The chain is made with two different colors of clips, grouped into sets of 10. Chains of 100 are formed by connecting sets of 10 in alternating colors, and when the chains of 100 are connected to make a chain of 1,000, each group of 100 is marked.

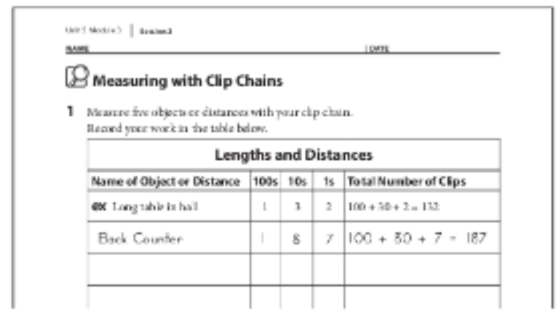




Lesson Thirteen: Measuring with Clip Chains

Students revisit the clip chain they made last session, or as much of the chain as the teacher can display in the classroom. Then students help use the displayed chain, as well as the sections saved from the previous session, to make 10 chains of 100 clips. Student pairs use the smaller chains to measure objects and distances in and around the classroom.





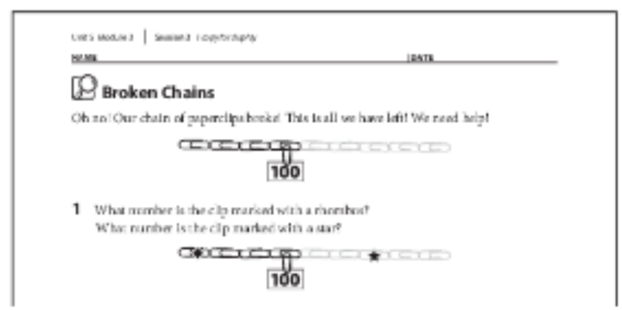
Measuring with Clip Chains

1 Measure five objects or distances with your clip chain. Record your work in the table below.

Lengths and Distances				
Name of Object or Distance	100s	10s	1s	Total Number of Clips
Long table in hall	1	3	2	100 + 30 + 2 = 132
Back Counter	1	8	7	100 + 80 + 7 = 187

Lesson Fourteen: Broken Chains

In this session students transfer their experiences with the clip chain of 1,000 from working with real clips to working with pictures of broken chains that present a variety of problems. The class works together to solve some broken chain problems, and then students complete a related assignment in their Student Books.



Broken Chains

Oh no! Our chain of paperclips broke! This is all we have left! We need help!

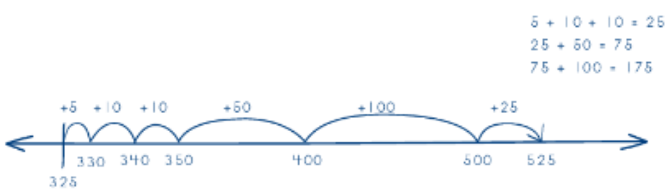
100

1 What number is the clip marked with a rhombus?
What number is the clip marked with a star?

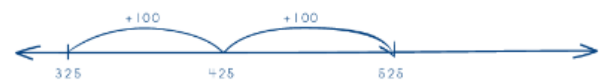
100

Lesson Fifteen: From Chain to Number Line

Today's session opens with a story about some children who took their clip chain to the park, laid it out on the grass, and climbed into the trees, where they could see the chain and the labels marked with multiples of 100, but not the individual clips. Students work with a number line marked in multiples of 100 to solve several problems as a class and then complete a related assignment in their Student Books.



Student C *I just counted by 100s, like 325 plus 100, and then 425 plus 100, and I landed on 525.*



Weeks Four and Five:

Lesson Sixteen: Unit 5 Post-Assessment
To start the session, the teacher introduces a new Work Place game that involves counting forward and backward by hundreds from different 3-digit numbers on an open number line. When most students understand how to play the game, they take the Unit 5 Post-Assessment, and then go to Work Places, including the new one, as time allows. Introducing Work Place 5E Jump-A-Hundred Players take turns rolling a die and flipping a coin to move either forward or backward by hundreds on a number line. After both players have had five turns, each player circles their final number, and the player whose number is closer to 500 wins the game.

Lesson Seventeen: Unifix Cube Sequences, Part 1
Students examine two different sequences of Unifix cubes. In each case, they share observations about the first few arrangements and use their observations to build and make predictions about arrangements further along in the sequence.

Lesson Eighteen: Unifix Cube Sequences, Part 2
Today students again work as a group to discuss two Unifix cube sequences. Then students work individually or in pairs to figure the 4th, 5th, and 10th configurations of a new sequence in their Student Books.

Lesson Nineteen: Pattern Block Sequences
Work with patterns continues as the class investigates two different sequences of pattern blocks, making observations and looking for patterns that will enable them to build the next few arrangements and sketch or describe larger arrangements.

Lesson Twenty: Tile Sequences
Today students work as a group to discuss two tile sequences. Then students work individually or in pairs to figure the 4th, 5th, and 10th configurations of a new sequence in their Student Books and solve a variety of related problems.

Interdisciplinary / Real World / Global Connections

- This unit provides students with the context of money for counting by 5s, 10s and 25s. The connection to money offers a real-world context for extending these counting partners to larger numbers.
- The final module in the unit is algebraic in nature, encouraging students to observe and describe sequences as they search for patterns and generalizations that will enable them to build and represent succeeding arrangements in those sequences.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

Support:

- When applicable give students smaller numbers to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

MLL (Multilingual Learners)**:**

- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words.
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play in a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

Unit 5 Pre-Assessment

NAME | DATE

Unit 5 Pre-Assessment page 1 of 4

1 Count by 10s or 100s to fill in the missing numbers.

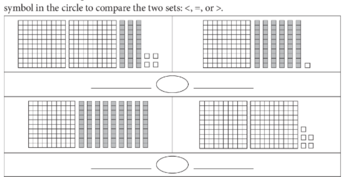
a 25, 35, _____, _____, 65, _____, 85, _____, _____, _____, 125

b 138, 148, _____, 168, _____, _____, 198, _____, _____, _____

c 46, 146, 246, _____, _____, _____, 646, _____, _____, _____

d _____, 113, 213, _____, _____, 513, _____, 713, _____, _____

2 Count the base ten pieces and write the number under each set. Then write the symbol in the circle to compare the two sets: <, =, or >.



3 Fill in the empty boxes in the table below.

Number	Number Name in Words	Expanded Form
438	Four hundred thirty-eight	400 + 30 + 8
759		
	Two hundred eighty-five	
		300 + 6
815		

(continued on next page)

NAME | DATE

Unit 5 Pre-Assessment page 2 of 4

4 Find each sum.

450 + 10	316 + 10	10 + 907	348 + 100	100 + 415	706 + 100

5 Find each difference.

336 − 10	513 − 10	702 − 10	331 − 100	916 − 100	707 − 100

6 Choose one of the subtraction problems below. Pick the one that seems best for you—not too hard and not too easy. Use numbers, labeled sketches, or words to solve the problem. Show all your work.

25 − 9	52 − 26	73 − 35	174 − 46	243 − 177

7 Choose one of the addition problems below. Pick the one that seems best for you—not too hard and not too easy. Use numbers, labeled sketches, or words to solve the problem. Show all your work.

15 + 8	35 + 26	46 + 27	134 + 39	148 + 225

(continued on next page)

NAME | DATE

Unit 5 Pre-Assessment page 3 of 4

8 Yusef and Matt are going to the school store. This picture shows how much money each boy has to spend.

a How much money does Yusef have in his hand? _______ ¢

b How much money does Matt have in his hand? _______ ¢

c How much more money does Yusef have than Matt? Use numbers, labeled sketches, or words to solve the problem. Show your work.

9 Here are Cora's hands. She has 2 dimes and a nickel in the hand that is closed.

a How much money does Cora have in her open hand? _______ ¢

b How much money does Cora have in both hands all together? Use numbers, labeled sketches, or words to solve the problem. Show your work.

Cora has _______ ¢ in both hands.

(continued on next page)

NAME | DATE

Unit 5 Pre-Assessment page 4 of 4

10 Max has 3 dimes, 2 nickels, and 1 penny in his pocket. How much money does Max have? Fill in the bubble to show.

- ○ $41.00
- ○ $4.10
- ○ 41¢
- ○ 4.1¢

11 Mr. Black has 5 dollar bills, 4 dimes, and 4 nickels in his pocket. How much money does Mr. Black have in his pocket? Fill in the bubble to show.

- ○ $560
- ○ $5.60
- ○ $0.560
- ○ 56¢

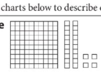
Unit 5

NAME | DATE

Three-Digit Numbers Checkpoint page 1 of 2

1 Fill in the charts below to describe each set of base ten pieces.

Practice



Number _______

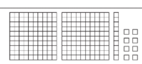
Hundreds, Tens and Ones

_______ Hundreds, _______ Tens, _______ Ones

Expanded Form

_______ + _______ + _______ = _______

a



Number _______

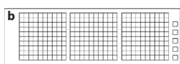
Hundreds, Tens and Ones

_______ Hundreds, _______ Tens, _______ Ones

Expanded Form

_______ + _______ + _______ = _______

b



Number _______

Hundreds, Tens and Ones

_______ Hundreds, _______ Tens, _______ Ones

Expanded Form

_______ + _______ + _______ = _______

2 Which number is greater, 313 or 331?

a _______ is greater.

b How do you know? Use numbers, sketches or words to explain your answer.

(continued on next page)

NAME | DATE

Three-Digit Numbers Checkpoint page 2 of 2

3 Count by 10s to fill in the missing numbers.

a 12, 22, 32, _____, _____, 62, _____, _____, 92, _____, _____, _____, 122

b 114, 124, 134, _____, _____, _____, 174, _____, _____, _____

c 157, 167, 177, _____, _____, 207, _____, _____, 237, _____, 257, _____

4 Which number has the same value as the expanded form? Fill in the bubble to show.

a 400 + 20 + 5
- ○ 4,025
- ○ 425
- ○ 245
- ○ 524

b 500 + 10 + 3
- ○ 503
- ○ 5,013
- ○ 500,103
- ○ 513

c 600 + 8
- ○ 608
- ○ 68
- ○ 6,080
- ○ 6,008

5 James has three digit cards. Help him arrange the cards to make the smallest 3-digit number possible.

9 3 5 → ☐ ☐ ☐

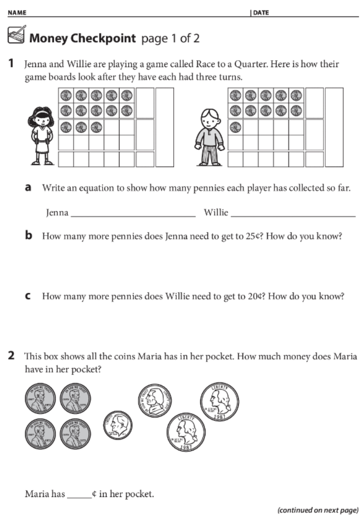
6 Add the numbers in each pair of problems and then write the correct symbol in the circle to compare the sums. Use less than <, equal to =, or greater than >.

500 + 30 + 1 ○ 400 + 90 + 9

300 + 80 + 7 ○ 400 + 10 + 8

Checkpoint

<u>Money Checkpoint</u>



NAME | DATE

Money Checkpoint page 1 of 2

1 Jenna and Willie are playing a game called Race to a Quarter. Here is how their game boards look after they have each had three turns.

a Write an equation to show how many pennies each player has collected so far.

Jenna ____________ Willie ____________

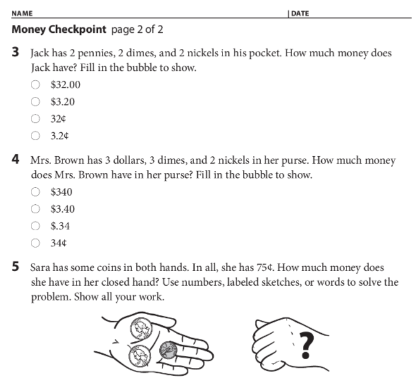
b How many more pennies does Jenna need to get to 25¢? How do you know?

c How many more pennies does Willie need to get to 20¢? How do you know?

2 This box shows all the coins Maria has in her pocket. How much money does Maria have in her pocket?

Maria has _____¢ in her pocket.

(continued on next page)



NAME | DATE

Money Checkpoint page 2 of 2

3 Jack has 2 pennies, 2 dimes, and 2 nickels in his pocket. How much money does Jack have? Fill in the bubble to show.

- ○ $32.00
- ○ $3.20
- ○ 32¢
- ○ 3.2¢

4 Mrs. Brown has 3 dollars, 3 dimes, and 2 nickels in her purse. How much money does Mrs. Brown have in her purse? Fill in the bubble to show.

- ○ $340
- ○ $3.40
- ○ $.34
- ○ 34¢

5 Sara has some coins in both hands. In all, she has 75¢. How much money does she have in her closed hand? Use numbers, labeled sketches, or words to solve the problem. Show all your work.

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 5 Post-Assessment

Unit 5 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–d Counts by 10s or 100s to fill in the missing numbers. *41, 51, 71, 91, 101, 111* *562, 582, 592, 612, 622, 632* *317, 417, 517, 717, 817, 917* *8, 308, 408, 608, 808, 908*	2.NBT.2 2.NBT.8	**2 pts. per problem (8 total):** • 2 pts. for entering all 6 missing numbers in a sequence correctly • 1 pt. for entering half or more of the 6 missing numbers in a sequence correctly	
2 Counts 2 collections of base ten pieces, expresses each quantity as a 3-digit number, and uses the correct symbol (<, =, >) to compare the two. *234 > 161; 190 < 205*	2.NBT.1 2.NBT.3	**3 pts. per problem (6 total):** • 1 pt. for counting a collection accurately and writing the correct number to represent the amount (total 2 pts.) • 1 pt. for each symbol used correctly	
3 Reads and writes 3-digit numbers in numeral form, word form, and expanded notation. *four hundred sixty-seven, 400 + 60 + 7* *329, 300 + 20 + 9* *913, nine hundred thirteen* *eight hundred five, 800 + 5*	2.NBT.3	**8 pts.** • 1 pt. for each correct entry in the table (do not dock points for mis-spelling the number words)	
4 Adds 10s and 100s to 3-digit numbers. *380, 425, 118, 329, 416, 303*	2.NBT.7 2.NBT.8	**6 pts.** • 1 pt. for each correct answer	
5 Subtracts 10s and 100s from 3-digit numbers. *235, 708, 593, 341, 713, 505*	2.NBT.7 2.NBT.8	**6 pts.** • 1 pt. for each correct answer	
6 Solves a 2- or 3-digit subtraction problem; shows work. *16, 26, 38, 128, or 66*	2.NBT.5 2.NBT.9	**2 pts.** • 1 pt. for using a viable strategy that could lead to the correct answer • 1 pt. for the correct total	
		Subtotal page 1	

Unit 5 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
7 Solves a 2- or 3-digit addition problem; shows work. *23, 61, 73, 173, or 373*	2.NBT.5 2.NBT.9	**2 pts.** • 1 pt. for using a viable strategy that could lead to the correct answer • 1 pt. for the correct total	
8a–c Counts two collections of quarters, dimes, nickels, and pennies, and finds the difference between the two amounts. *Lily: 32¢ Kendra: 70¢* *Kendra has 38¢ more than Lily.*	2.MD.8 2.MP.1	**4 pts.** • 1 pt. for counting the money in Lily's hand accurately • 1 pt. for counting the money in Kendra's hand accurately • 1 pt. for a viable strategy that could lead to the correct answer • 1 pt. for the correct difference	
9a–b Counts two amounts of money, the first shown in pictures of coins, the second expressed in words, and finds the total of the two amounts. Shows work for addition problem. *Timmy has 41¢ in his open hand;* *Timmy has 70¢ in all.*	2.MD.8 2.MP.1	**3 pts.** • 1 pt. for correctly counting the amount in Timmy's open hand • 1 pt. for showing viable work that could lead to the correct answer • 1 pt. for the correct total	
10 Counts mixed coins and chooses the correct notation to show the total. *Choice 3, 96¢*	2.MD.8	**1 pt.**	
11 Counts dollar bills and mixed coins, and chooses the correct notation to show the total. *Choice 2, $7.60*	2.MD.8	**1 pt.**	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**47 pts.**	

* **Meeting Standard** 36–47 points (75%–100% correct) **Approaching Standard** 24–35 points (50–74% correct) **Strategic** 12–23 points (25–49% correct) **Intense** 11 points or less (

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade Two / Mathematics
Unit of Study	Unit 6: Geometry
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices: **2.MP.1 Make sense of problems and persevere in solving them.** 2.MP.2 Reason abstractly and quantitatively. **2.MP.3 Construct viable arguments and critique the reasoning of others.** **2.MP.4 Model with mathematics.** 2.MP.5 Use appropriate tools strategically. 2.MP.6 Attend to precision. 2.MP.7 Look for and make use of structure. 2.MP.8 Look for and express regularity in repeated reasoning. **Priority/Focus Standards:** **2.G.A.1-** Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.1 Identify triangles, quadrilaterals, pentagons, hexagons, and cubes. **2.G.A.2-** Partition a rectangle into rows and columns of same-size squares and count to find the total number of them. **2.G.A.3-** Partition circles and rectangles into two, three, or four equal shares, describe the shares

using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.
2.MD.C.8- Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. Example: If you have 2 dimes and 3 pennies, how many cents do you have?
2.MD.D.10- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simply put-together, take-apart, and compare problems using information presented in a bar graph.

Supporting Standards:
2.NBTA.1- Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones.
2.NBT.A.3- Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.
2.NBT.B.5- Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
2.NBT.B.6- Add up to four two-digit numbers using strategies based on place value and properties of

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Find the total number of objects in an array with up to 5 rows and 5 columns, using addition.	1. Array models represent repeated addition equations.
2. Write an equation to represent the total number of objects in an array with up to 5 rows and 5 columns as the sum of equal addends	2. An equation can have more than two addends.
3. Recognize and draw shapes having specified attributes.	3. Shapes are categorized by a specific set of attributes.

4. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.	4. Polygons are named based on the number of sides and angles.
5. Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.	5. The area of a rectangle is the number of square units inside the shape.
6. Partition circles and rectangles into 2 and 4 equal parts.	6. Shapes can be partitioned in halves and fourths.
7. Use the terms halves and half, fourths, quarters, fourth of, and quarter of to talk about the 2 or 4 equal parts into which circles and rectangles have been partitioned.	7. When shapes are partitioned into 2 equal parts, the parts are called halves; when shapes are partitioned into 4 equal parts, the parts are called fourths or quarters.
8. Describe whole circles and rectangles as 2 of two equal parts or 4 of four equal parts.	8. We can identify amounts less than 1 whole using fractional language.
9. Demonstrate an understanding that equal parts of identical wholes do not have to be the same shape.	9. There is more than 1 way to partition shapes into halves and fourths.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. 1. How do fractions help describe shapes and groups? 2. How can you find the area of given shapes? 3. Why do we need mathematical operations? (addition/subtraction)	1. Fractions represent equal parts of shapes or groups and help to describe these parts. 2. The area of a shape can be found by counting units. 3. Operations create relationships between numbers and when acted up result and a new number.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.c**: Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
Books/Media: ● Song: Know Your Quadrilaterals ● Song: Quad **Children's Literature:** ● *The Greedy Triangle* by Marilyn Burns ● *A Clock for the Dreamer* by Aileen Friedman ● *Sweet Clara and the Freedom Quilt* by Deborah Hopkinson ● *The Patchwork Quilt* by Valerie Flournoy ● *Shape by Shape* by Suse MacDonald ● *The Warlord's Puzzle* by Virginia Pilegard ● *Fraction Action* by Loreen Leedy ● *Grandfather Tang's Story* by Ann Tompert ● *If You Were a Quadrilateral* by Molly Blaisdell ● *The Josephina Story Quilt* by Eleanor Coerr ● *The Tortilla Quilt Story* by Jane Tenorio-Coscarelli ● *Sam Johnson and the Blue Ribbon Quilt* by Lisa Campbell Ernst **Online Resources / Websites:** ● MLC Geoboard App ● MLC Pattern Shapes App ● Game: Concentration ● Patch Tool ● Polygon Playground ● Tessellate!

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Area: the total space taken up by a flat (2-D) surface or shape of an object.
Array: a way of arranging things in rows and columns.
Column: a way in which objects, such as numbers, can be arranged.
Congruent: having the same size and shape.
Equal parts: having the same portion, division, piece, or segment of a whole.
Equation: a mathematical sentence that has two equal sides separated by an equal sign.
Equilateral: An equilateral triangle is a triangle that has three sides that are all the same length and three angles that are all the same size (60°).
Fourth: one of four equal parts.
Half halves: one of two equal parts into which something can be divided.
Hexagon: a six-sided polygon.
Isosceles triangle: a triangle with two sides that are the same length and one side that is a different length.
Line of symmetry: a line that cuts a shape exactly in half.
Octagon: a polygon made up of 8 sides.
Parallel lines: two lines in the same plane that are at equal distance from each other and never meet.
Patterns: things that repeat in a logical way.
Pentagon: a plane figure that has five sides and five corners.
Quadrilateral: a four-sided two-dimensional shape.
Quarter (one-fourth): one of four equal parts of a whole; one quarter; ¼.
Rhombus: special kind of four-sided figure known as a quadrilateral.
Right angle: an angle formed by two lines that are perpendicular to each other: an angle of 90 degrees.
Row: An arrangement of numbers or objects from left to right.
Scalene triangle: a triangle in which all three sides are a different length.
Symmetrical: A shape has symmetry if a central dividing line (a mirror line) can be drawn on it, to show that both sides of the shape are the same.
Symmetry: when it is the same on both sides.
Tessellation: when a flat surface, like a floor or a piece of paper, is covered with repeating geometric shapes.
Thirds: one part of three equal parts.
Trapezoid: a flat, closed shape having 4 straight sides, with one pair of parallel sides.

Vertex: the location where two or more lines or edges are connected.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Over the course of this unit, students investigate two-dimensional shapes, fractions (halves and fourths), congruence, symmetry, and transformations (slides, flips, and turns) using a variety of tools and models. There is a strong emphasis on identifying, describing, constructing, drawing, comparing, contrasting, and sorting various types of triangles and quadrilaterals, as well as other shapes, throughout the unit. The first-grade focus on composing and decomposing shapes resurfaces at a more sophisticated level in Modules 2–4 as students are introduced to concepts of tiling a plane (tessellating) and finding the areas of shapes by counting the number of units it takes to cover them without leaving any gaps or holes.

Learning Tasks Per Week (Including Instructional Strategies)

Week One:

Lesson One: Introducing Work Place 6A Last Shape In Wins
To open the new unit about geometry, the teacher introduces Last Shape In Wins. In this game, students take turns fitting triangles, rhombuses, trapezoids, and hexagons into a large hexagonal outline. Next, the students take a unit pre-assessment, and then go out to Work Places as they finish and turn in their assessments. Introducing Work Place 6A Last Shape In Wins Players take turns placing pattern blocks on the large hexagon, using the lines drawn on the board to help position the blocks accurately. On each turn, players place one shape—a triangle, a trapezoid, a blue rhombus, or a hexagon—on the board. The player who can place the last block and complete the entire hexagon wins.

Lesson Two: The Greedy Triangle Learns a Lesson
The session begins with a reading The Greedy Triangle by Marilyn Burns. The book, in which a dissatisfied triangle turns to a shapeshifter again and again to add sides and angles to his frame, serves as an excellent anchor to the upcoming sessions on the attributes of polygons. After the reading, the teacher challenges students to consider how the triangle could change his shape without adding a side or angle. Students then work individually to construct and record four different triangles.

Lesson Three: Constructing & Drawing Quadrilaterals
This session begins with a review of the story from the previous session. Then the teacher leads students in a discussion in which

they compare different types of quadrilaterals. Students then work individually to construct and record four different quadrilaterals.

Lesson Four: Sorting Triangles & Quadrilaterals
The session begins with the teacher leading the students in sorting a set of triangles and quadrilaterals that were created in Sessions 2 and 3. The polygons are sorted by specific attributes as the class reviews and learns some new vocabulary terms associated with these shapes. Students then work in groups of three to sort triangles and quadrilaterals in a variety of ways.

Lesson Five: 5 Guess My Shape
Students cut apart sheets to make their own sets of paper shapes to use in a new sorting activity. The teacher holds up an envelope containing one shape from the set—the "mystery shape." She then gives one clue at a time while students sort through their sets to find the shapes that match the one being described. The clues go from general to more specific until all but the shape that matches the one in the envelope have been eliminated.

Week Two:

Lesson Six: Exploring Area with Pattern Blocks
The session opens with a discussion of area, a key term for this module. The teacher then assigns the green pattern block triangle an area of 1, and students work to find the areas of some of the other pattern blocks, as well as more complex figures built of pattern blocks.

Lesson Seven: More Area Explorations with Pattern Blocks
This session builds on the previous as students consider how the area of a figure will change when the unit of measure changes. Students work to measure a series of shapes using two or even three different units each time, each unit proportional to the others.

Lesson Eight: Exploring Area with Geoboards
In this session, students create shapes on their geoboards that have an area of 6 units, using a square instead of a triangle as the unit of measure. Then they work to find the areas of simple and complex shapes on their geoboards.

Lesson Nine: Work Place 6B Find the Area & Work Place 6C Make the Area
The teacher introduces two new Work Places related to the area. In the first, students find the areas of various geoboard figures. In the second, they build figures of various areas on their boards. In both cases, they use labeled sketches and numbers to show and explain their work. Introducing Work Place 6B Find the Area Students work individually to find the areas of different figures on four different activity sheets. The sheets, which increase in difficulty, each contain sketches of figures on geoboards. Introducing

Work Place 6C Make the Area Students work individually to create figures with a given area. The four activity sheets challenge students to create four figures for each of the following areas 6, 7, 8, and 9 square units. **Lesson Ten:** Measuring Paper Rectangles Students estimate and find the areas of several different rectangles, as measured in square units.
Week Three: **Lesson Eleven:** A Cloak for the Dreamer: Exploring Tessellation This module opens with a reading of a delightful book that introduces tessellation, a concept closely related to area, and sets the stage for many of the sessions in the latter half of Unit 6. After reading and discussing the book with the class, the teacher introduces a new Work Place that involves finding the fewest pattern blocks required to cover a variety of figures. Introducing Work Place 6D Fill for Less Students work individually to fill different figures using as few pattern blocks as possible. Once students have found a solution, they color in the figure using colors that match the pattern blocks. **Lesson Twelve:** The Churn Dash Quilt, Part 1 Today, the teacher will introduce a new project—making a class quilt out of paper patches. Students examine and discuss the shapes and fractions of shapes that will be pieced together to form one quilt block. Then each student makes a copy of the quilt block to contribute to the class quilt. **Lesson Thirteen:** The Churn Dash Quilt, Part 2 In the second of three quilting sessions, students consider the shape and arrangement of the quilt they will make with their completed blocks. Students work in pairs to arrange tiles that represent quilt blocks into as many rectangular arrays as possible. After students consider all possible arrangements, they vote on one and their quilt blocks are glued in place to form a class quilt. **Lesson Fourteen:** The Churn Dash Quilt, Part 3 Students discuss the completed class quilt, sharing observations about the shapes, numbers, and patterns they can see now that all the individual blocks have been combined. Each student then records an observation about the quilt to be used as part of a class display. **Lesson Fifteen:** Exploring Area with Patchwork Quilts In this session, students connect the idea of measuring area with patchwork quilting as they determine how much of a quilt block is covered in each of two different colors. Students count the different colored patches on several different quilt blocks, label them,

and write equations to show the area. Then the teacher introduces a related Work Place. Introducing Work Place 6E Halves and Half-Nots Students do at least one of four worksheets in which they find the area of the gray and the white regions on two different quilt blocks and determine whether each block is exactly half gray and half white, or more than half of one color or the other.

Week Four:

Lesson Sixteen: Unit 6 Post-Assessment
Students complete the Unit 6 Post-Assessment today. As they finish and turn in their assessments, they get their folders and go out to Work Places.

Lesson Seventeen: Eight-Part Inventions: Creating Patchwork Blocks
This is the first of three sessions in which students make their own paper mini quilts in order to learn more about shapes and fractions. Today's activities feature halves and fourths, as students fold and cut paper to make their own unique quilt blocks.

Lesson Eighteen: Exploring Symmetry in Quilt Blocks
Students examine the quilt blocks they made in the previous session and determine the number of lines of symmetry in their own blocks and those of their classmates. The blocks are sorted into groups according to how many lines of symmetry they have, and then informally graphed on the floor. Students make observations about this graph and consider which of displayed blocks they want to use to create their mini-quilts next session.

Lesson Nineteen: Making Patchwork Mini-Quilts
In this final mini-quilt session, students make four copies of their favorite block. Then the teacher calls the students together and demonstrates how transformations such as slides, flips, and turns (translations, reflections, and rotations) are used to create unique ways to arrange the blocks into a mini quilt. Students then work to explore all the possible mini quilts they might arrange before gluing down their favorite arrangement.

Lesson Twenty: The Sandwich Problem
Today, the context for exploring shape fractions shifts from quilt blocks to sandwiches as students consider the problem that arises when the triplets—Abby, Brisa, and Cary—each ask the babysitter to cut their sandwiches in fourths. When the sandwiches arrive as requested, two of the triplets are very upset because they think their fourths are smaller than their sister's. Students work in small groups to investigate the situation, and each group prepares a poster to share with the class describing their strategies and solutions.

Interdisciplinary / Real World / Global Connections

- The context of quilting is a real-world application chosen to provide students with an introduction to area, tessellation and creating rectangles with the same areas, but different dimensions. Through this context, students get more practice working with polygons using pattern shapes.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☐ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☒ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

Support:

- When applicable give students smaller numbers to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

MLL (Multilingual Learners)**:**

- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words.
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

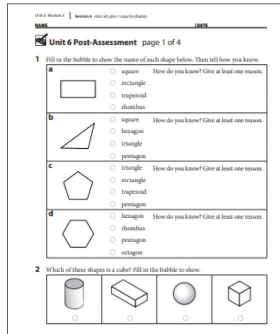
Include an overview of authentic assessments

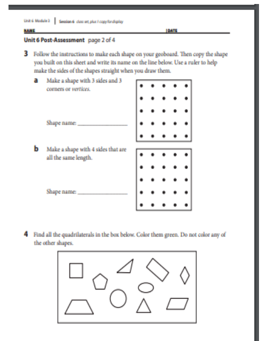
Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

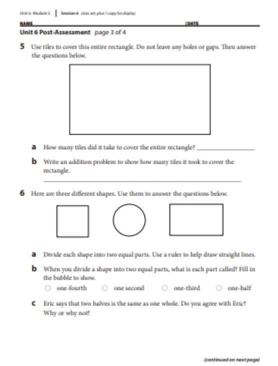
- Unit 6 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work
- Problem Strings

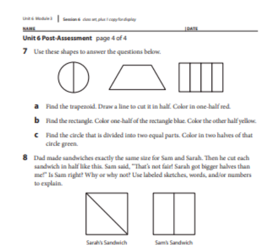
Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 6 Post-Assessment:









Unit 6 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–d Identifies each shape by name and gives at least one reason for choice. *rectangle, triangle, pentagon, hexagon* *Explanations will vary.*	2.G.1	**3 pts. per item** • 1 pt. for correct shape name, ***and*** • 1 pt. for Level 0 explanation ***or*** 2 pts. for Level 1 explanation (see Scoring Notes below)	
2 Identifies which of the 4 shapes is a cube. *Choice 4*	2.G.1	**1 pt.**	
3a–b Draws shapes to match sets of specified attributes, and labels each shape with correct name. *triangle* *square or rhombus*	2.G.1	**2 pts. per item** • 1 pt. for drawing a shape that matches the set of specified attributes • 1 pt. for labeling the shape with the correct name (do not subtract points for spelling errors)	
4 Identifies and colors in all the quadrilaterals in a collection of mixed shapes. *top row: square, rectangle, rhombus* *bottom row: trapezoid, parallelogram*	2.G.1	**5 pts.** • 1 pt. for each shape correctly identified as a quadrilateral • subtract 1 pt. for each shape marked that is NOT a quadrilateral	
5a Finds the number of tiles it takes to cover a rectangle. *8 tiles*	2.G.2	**1 pt.**	
5b Writes an addition equation to represent the number of tile it took to cover the rectangle. *Responses will vary.* *Examples: 4 + 4 = 8; 2 + 2 + 2 + 2 = 8*	2.OA.4	**1 pt.**	
		Subtotal page 1	

Unit 6 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
6a Divides a circle, a square, and a rectangle into 2 equal parts each. *Drawings will vary somewhat.*	2.G.3	**3 pts.** • 1 pt. for each reasonably accurate drawing	
6b Chooses the correct term for each of the equal parts created in 6a. *Choice 4, one-half*	2.G.3	**1 pt.**	
6c Agrees with the statement that 2 halves is the same as 1 whole, and explains why. *Yes; explanations will vary. Example: When you cut something in half, you get 2 halves.*	2.G.3	**2 pts.** • 1 pt. for agreeing with Eric • 1 pt. for a viable explanation	
7a–c Identifies and colors in halves, partitions shapes into 2 equal parts *Divides trapezoid into 2 equal parts, colors 1 part out of 2 red. Colors half of the rectangle blue, and the other half yellow. Colors in ½ of the circle green.*	2.G.3	**3 pts.** • 1 pt. for each correct response	
8 Demonstrates understanding that equal shares on identical wholes can have different shapes. *No, Sam is not right. Explanations will vary. Example: The sandwiches are the same, so it doesn't matter how you cut them.*	2.G.3	**2 pts.** • 1 pt. for disagreeing with Sam • 1 pt. for a viable explanation	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**35 pts.**	

* **Meeting Standard:** 27–35 points (75%–100% correct) **Approaching Standard:** 18–26 points (50–74% correct) **Strategic:** 9–17 points (25–49% correct) **Intensive:** 8 points or less (

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 7: Measurement, Fractions & Multi-Digit Computation with Hungry Ants
Pacing	4 Weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
2.MP.1 Make sense of problems and persevere in solving them.
2.MP.2 Reason abstractly and quantitatively.
2.MP.3 Construct viable arguments and critique the reasoning of others.
2.MP.4 Model with mathematics.
2.MP.5 Use appropriate tools strategically.
2.MP.6 Attend to precision.
2.MP.7 Look for and make use of structure.
2.MP.8 Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

2.OA.1 Solve one- and two-step addition and subtraction story problems with sums and minuends to 100 involving situations of adding to, putting together, taking from, taking apart, and comparing, with unknowns in all positions.
2.MD.1 Select and use the appropriate tool for measuring the length of an object.
2.MD.1 Measure the length of an object in centimeters and meters using rulers, meter sticks, and measuring tapes.

2.MD.3 Estimate length in centimeters and meters.
2.MD.4 Determine exactly how much longer one object is than another and express the difference between the two lengths in terms of a standard unit of length.
2.MD.5 Solve addition and subtraction story problems with sums and minuends to 100 involving lengths given in the same units.
2.MD.8 Solve money story problems involving dollars, quarters, dimes, nickels, and pennies; use $ and ¢ signs appropriately.
2.G.3 Partition a circle (rectangle) into 2, 3, or 4 equal parts.
2.G.3 Use the terms halves, half, thirds, third of, fourths, quarters, a fourth of to talk about the equal parts into which a circle (rectangle) has been partitioned.

Supporting Standards:

2.MD Measure length to the nearest whole unit in metric units
2.NBT.7 Add and subtract with sums and minuends to 1000.
2.NBT.7 Use concrete models or drawings to add and subtract with sums and minuends to 1000.
2.NBT.7 Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to add and subtract with sums and minuends to 1000.
2.NBT.7 Use written numbers and symbols to represent strategies for adding and subtracting with sums and minuends to 1000.
2.NBT.7 Add with sums to 1000 using strategies that involve adding hundreds to hundreds, tens to tens, and ones to ones.
2.NBT.7 Subtract with minuends to 1000 using strategies that involve subtracting hundreds from hundreds, tens from tens, and ones from ones.
2.NBT.7 Add with sums to 1000 using strategies that involve composing a hundred or a ten.
2.NBT.7 Subtract with minuends to 1000 using strategies that involve decomposing a hundred or a ten.
2.NBT.9 Explain why strategies for adding and subtracting 2- and 3-digit numbers work, using place value and the properties of operations.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Solve one- and two-step addition and subtraction story	1. Addition and subtraction story problems follow 5

problems with sums and minuends to 100 involving situations of adding to, putting together, taking from, taking apart, and comparing, with unknowns in all positions.	predictable structures and knowing these structures can make writing equations to solve for missing information easier.
2. Add and subtract with sums and minuends to 1000.	2. Addition and subtraction strategies used with numbers to 100 can be extended to numbers within 1000.
3. Use concrete models or drawings to add and subtract with sums and minuends to 1000.	3. Manipulatives and drawings can be used to model addition and subtraction problems.
4. Use written numbers and symbols to represent strategies for adding and subtracting with sums and minuends to 1000.	4. Equations and models can be used to record and explain mathematical thinking.
5. Add with sums to 1000 using strategies that involve adding hundreds to hundreds, tens to tens, and ones to ones.	5. When adding multi-digit numbers, it is important to add like place values; ones to ones, etc.
6. Subtract with minuends to 1000 using strategies that involve subtracting hundreds from hundreds, tens from tens, and ones from ones.	6. When subtracting a multi-digit from another multi-digit it is important to subtract like place values; ones from ones, etc.
7. Add with sums to 1000 using strategies that involve composing a hundred or a ten.	7. When addition produces more than 10 tens a hundred is made, when a number produces more than 10 hundreds a thousand is made.
8. Subtract with minuends to 1000 using strategies that involve decomposing a hundred or a ten.	8. Numbers can be decomposed in many ways; 2 hundreds, 3 tens and 5 ones can be decomposed to 1 hundred, 13 tens and 5 ones.
9. Explain why strategies for adding and subtracting 2- and 3-digit numbers work, using place value and the properties of operations.	9. There are multiple ways to add and subtract.

10. Select and use the appropriate tool for measuring the length of an object.	10. Different measuring tools are available for measuring length.
11. Measure the length of an object in centimeters and meters using rulers, meter sticks, and measuring tapes	11. An object's length does not change if the units are the same, even if the tool used is different.
12. Estimate length in centimeters and meters.	12. Using benchmarks we can approximate the length of an object.
13. Measure length to the nearest whole unit in metric units.	13. Objects can be measured with tools from end to end with no gaps or overlaps.
14. Determine exactly how much longer one object is than another and express the difference between the two lengths in terms of a standard unit of length.	14. The difference in length between two objects can be determined using subtraction.
15. Solve addition and subtraction story problems with sums and minuends to 100 involving lengths given in the same units.	15. Strategies for adding and subtracting whole numbers can be applied to story problems involving measurement.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do we decide which tool to use to measure something? 2. Why is estimation an important tool?	1. The choice of measurement tool depends on the measurable attribute, the size of the object, and how precise we need the measurement. 2. Estimation is an important life skill that people use every day. Many real-life applications of math do not require exact answers. The problem situation determines the best estimation strategy to use. Estimation is also an effective strategy that promotes easy recognition of the reasonableness of an answer, to determine

3. How do operations affect numbers?	approximations in measuring, and for catching errors made when using calculators. 3. Operations involve combining and taking apart numbers using a variety of approaches to arrive at a new number result.
4. How can analyzing operations on numbers and the results help us to become more efficient at computation?	4. Analyzing problems and their answers can help us to see patterns that can lead to a deeper understanding of number sense and shortcuts for efficient computation.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
Books/Media: ● Home Learning Packet: Module 1 ● Home Learning Packet: Module 2 ● Home Learning Packet: Module 3 ● Home Learning Packet: Module 4 ● Amazon Book Link: Fractions and Decimals ● Amazon Book Link: Multiplication and Division **Informational Texts:** ● **Informational Books:** ○ For Good Measure ○ How Long or How Wide? ● **Media:** ○ Ant Anatomy

Online Resources / Websites:

- **MLC App:** Number Line App from MLC
- **MLC App:** Fractions
- Hidden Life of Ants
- **Game:** Strolling With My Gnomies
- **Game:** Coin Box
- **Game:** Dolphin Dash
- **Game:** Fuzz Bugs
- Workplace Sentence Frames

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Cent (¢): monetary unit equal to 1/100 of a dollar.
Centimeter (cm): a metric unit of length equal to 1/100 of a meter or about 2/5 of an inch.
Compare: to examine to note similarities and differences; to determine whether numbers are greater than, less than, or equal.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Dollar ($): the basic unit of U.S. currency.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Fourth: one part when a number, shape, or set is divided into exactly four equal parts; also called a quarter.
Fraction: a number expressed as some number of equal parts of a whole.
Greater Than: a symbol used to indicate that the number on the left is greater than the number on the right.
Half: one part when a number, shape, or set is divided into exactly two equal parts.
Hundreds: the numbers 100 to 999; also refers to the hundreds place.
Length: how long something is.
Less Than: a symbol used to indicate that the number on the left is less than the number on the right.
Meter (m): a metric unit of length equal to 100 centimeters or about 39 inches.

Ones: the numbers 0 to 9; also refers to the ones place.
Place Value: the value a digit has because of its place in a number; the name of the position a digit has in a number (such as "ones" or "tens").
Sum or Total: the result of adding two or more numbers.
Tens: the numbers 10 to 99; also refers to the tens place.
Third: one part when a number, shape, or set is divided into exactly three equal parts.
Unit: another name for 1 (the unit's column is the same as the ones column); also a standard amount in which attributes (length, duration, mass) can be measured and quantified.
Whole: all, everything; all the parts; undivided.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

This unit addresses metric measurement, fractions, and multi-digit addition and subtraction, set in the context of army ants, picnic ants, and imaginary ants who enjoy toys as much as second graders do. In Week 1, students discover that the average length of a worker army ant is 1 centimeter, make army ant rulers like the inchworm rulers they made in Unit 4 and use their new rulers to measure in metric units. In Week 2, an amusing children's book about ants serves as a springboard for investigating division and fractions. Weeks 3 and 4 feature a new set of story problems that revolve around a toy store for ants.

Learning Tasks Per Week (Including Instructional Strategies)

Week One: Students create army ant rulers to estimate and measure the lengths of objects in centimeters, which happens to be the average length of an army ant. The class then works together to combine ten rulers to make a meter and spends a session measuring longer lengths and distances in meters. Three new Work Places are introduced: a game that involves adding and subtracting 2-digit numbers; an activity that allows for more practice measuring in centimeters; and an activity in which students estimate, measure, and compare lengths of paper ant paths created by their classmates.

Lesson One: 1 Introducing Work Place 7A Race to the Cookie Jar To open the new unit, which features double and triple-digit computation, metric measurement, and fractions, the teacher introduces Race to the Cookie Jar. In this game, students spin three multiples of 10, adding the first two and then subtracting the last, to determine how many moves toward the finish they can take. When students understand how to play the game, they take a unit pre-assessment and then go out to Work Places as they finish. Introducing Work Place 7A Race to the Cookie Jar To start, each player chooses one side of the game board and places a marker at

0. Players take turns spinning the first two spinners on a triple spinner, adding the two numbers, then spinning a third spinner and subtracting that number from the sum of the first two. The player then moves her marker that number of spaces on a game board numbered in multiples of 10. The first player to reach the cookie jar wins the game.
Lesson Two: How Long Is an Army Ant? The teacher introduces metric measure by discussing army ants with students and then comparing the length of an army ant to a centimeter. Students work to understand this new unit of length by comparing it to an inch and to common objects such as the width of a finger. After the teacher models the steps for creating a centimeter army ant ruler, students make their own army ant rulers and use them to find things in the classroom that are about 1 centimeter long, between 1 and 10 centimeters long, and about 10 centimeters long.
Lesson Three: Estimate & Measure Centimeters To start the session, students number their army ant rulers so they are easier to read. Then they work in pairs to estimate and measure the length of various objects around the classroom. The teacher then reconvenes the class to discuss the work, and introduces a related Work Place, along with a special work station where students each create an ant path for use in the session after next. Introducing Work Place 7B Estimate & Measure Centimeters Students estimate and measure the lengths of different items around the room in centimeters, using their army ant rulers, regular rulers marked in centimeters, or tape measures marked in centimeters.
Lesson Four: One Hundred Army Ants and More Students combine some of their 10-centimeter rulers to form a meter, and identify objects in the classroom that are about 1 meter long. Then they work together to measure a distance of 14 meters in the hallway, the gym, or on the playground. Fourteen meters has special significance in the world of army ants, as students will discover. The session ends with students returning to Work Places and continuing to make their ant paths in pairs.
Lesson Five: Ant Paths Students add more detail to their ant paths and work as a group to estimate, measure, and compare the lengths of two different paths. The teacher then introduces Work Place 7C Ant Paths, a partner activity similar to the one completed as a group, and sends students out to Work Places if time allows. Introducing Work Place 7C Ant Paths Partners select two Ant Paths, roll them out, and estimate the lengths of the paths. Then they work together to measure both paths and find the difference between the two lengths.
Week 2: Module 2 opens with a reading of the book One Hundred Hungry Ants by Elinor J. Pinczes. Using the story as a point of departure, students work to arrange groups of 100 and then 120 ants in even marching rows of two, four, five, and ten lines. In the following session students consider the ways in which a group of hungry ants can evenly share one, two, and three granola bars, using denominators of 2, 3, and 4. As they move more deeply into fraction work, students create their own set of construction paper fraction strips and use them to play a game. The module ends with two sessions in which students work with fractions in the context of two different spinner experiments. The module ends with a metric measurement and fractions checkpoint.

Lesson Six: One Hundred Hungry Ants The teacher reads the book One Hundred Hungry Ants by Elinor J. Pinczes, to set the stage for solving story problems about ants. The students work together to figure out what would happen if the 100 ants in the story were divided into two equal lines, four equal lines, five equal lines, or ten equal lines. Then they work in pairs to select and solve problems in which a group of 120 ants is divided into equal lines.
Lesson Seven: Ant Treats This session gives students an opportunity to explore division and fractions as they imagine they are hungry picnic ants sharing granola bars. First, the teacher works with the class to divide one paper granola bar among two, three, and then four ants and creates a display of the results. Next, students investigate what happens when two granola bars are shared between two ants, and then among three. Students work in groups of three to devise a plan for sharing two paper granola bars and then divide and share actual bars before coming together as a group to share strategies. Students then work individually on a related assignment in their Student Books.
Lesson Eight: Fraction Races Students work with guidance from the teacher to create a set of construction paper fraction strips. These construction paper representations of halves, fourths, and eighths are used to compare fractions and build wholes. The teacher leads a discussion on how the fraction pieces can be combined to create other fraction pieces, and then introduces the game Fraction Race. In this game, players take turns spinning a spinner and collecting fractions in a race to build one whole.
Lesson Nine: Bug Spinner Experiments, Part 1 In this session and the next, students explore fractions in the context of two probability-based spinner experiments. Today, the teacher introduces the first spinner and explains the experiment. Students make predictions about the outcomes, then work in pairs to spin the spinner and record the outcomes. The class pools and discusses their results. The teacher then introduces Work Place 7D Fair Shares, an activity based on the Ant Treats activity students did earlier in this module. Introducing Work Place 7D Fair Shares Students share cookies between two, three, or four ants. After cutting and gluing paper cookies to show how they are shared, students look for and describe patterns in the fractional answers.
Lesson Ten: Bug Spinner Experiments, Part 2 This session opens with a short checkpoint on metric measuring and fractions. Then students repeat the experiment they conducted during the previous session, using a spinner that is not evenly divided between the two bugs. Again, students make observations about the outcome of spinning the spinner once, and predict the outcomes of 24 spins. Students work with partners to record their predictions and then conduct the experiment. Class results are compiled on the board and discussed.
Week 3: During the last two modules in this unit, students solve and pose story problems centered around a toy store for ants. The Ants' Toy Store receives and ships toys in cases of 100, boxes of 10, and packed individually. These models correspond to the hundreds, tens, and ones pieces in the sets of large base ten area pieces and make it possible for students to generate strategies for

adding and subtracting 3-digit numbers. Students share their strategies as well as money story problems throughout the module. They take a closer look at some of the most effective and efficient strategies in Session 4, when the class develops a set of strategy posters for reference throughout the school year. This module ends with a post-assessment. **Lesson Eleven:** 1 The Ants' Toy Store Today, the teacher sets the stage for a new story problem theme by presenting two scenes from a toy store and inviting students to talk about what they see. The teacher then introduces Work Place 7E The Gardener's Friend Game and plays the game with the class. Introducing Work Place 7E The Gardener's Friend Game Each player chooses a bug—either the praying mantis or the ladybug—and fills in their grid according to the results of a spinner. The first player to color all 300 squares is the winner. After the game, players work together to find total scores, compare the totals, and calculate the margin of victory.
Lesson Twelve: Introducing Toy Store Problems In this problem-solving session, the teacher displays an Ant Store shopping problem for the entire class to read and discuss. Students work in pairs to solve the problem and then share their results and strategies with the group. Then students work independently to solve several related problems.
Lesson Thirteen: Solving Toy Store Picture Problems The teacher presents another collection of story problems for students to solve. Each problem is shown in picture form first. Then the teacher reads the story that goes with the picture and asks students to select the matching "math talk" bubble. After students see all the problems, they work the first one as a class and then go out singly or in partners to work the rest.
Lesson Fourteen: A Closer Look at Our Strategies Before the session begins, the teacher looks through students' problem-solving papers from the previous session and chooses several responses to problems 1 and 2 to share with the class. The students who did the work explain their thinking to the class, and then the teacher works with all students to create a poster for each approach. These strategy posters are then displayed for students' reference as they complete a related set of story problems in their Student Books.
Lesson Fifteen: Unit 7 Post-Assessment Students complete the Unit 7 Post-Assessment today. As they finish and turn in their assessments, they get their folders and go out to Work Places.
Week 4: In the conclusion to this unit, students are given the chance to draw, write and share their own toy store problems. During the first two sessions of the module, students create and solve their own problems. Then the class solves several student-posed problems together, and students spend the remaining two sessions selecting and solving classmates' problems independently. Students' problem-solving papers can be saved as Work Samples if the teacher desires. **Lesson Sixteen:** Creating Toy Store Problems, Part 1 Over the next five sessions, students create their own toy story problems and

spend time solving problems created by other students. In this session and next, students work to create their problems. The teacher begins the process by creating a picture problem that shows a scene from a toy store. Students offer suggestions for how to complete the picture. Then students begin work creating their own picture problems.
Lesson Seventeen: Creating Toy Store Problems, Part 2 Over the next five sessions, students create their own toy story problems and spend time solving problems created by other students. In this session and next, students work to create their problems. The teacher begins the process by creating a picture problem that shows a scene from a toy store. Students offer suggestions for how to complete the picture. Then students begin work creating their own picture problems.
Lesson Eighteen: Solving Story Problems Together Before this session, the teacher goes through students' completed picture problems and selects two or three for the class to work on together. As each of these problems is presented, students work individually or in pairs to solve it, and then share their solutions and strategies as a group.
Lesson Nineteen: Shopping for Toy Store Problems, Part 1 Today the teacher reviews the procedure for choosing and solving story problems from the collection the class generated. The students then leave the discussion area a few at a time to shop for problems themselves. They select and work one problem at a time, completing as many as they can during this session. Shopping will continue in the next session. Finally, the teacher introduces and assigns the Cleaning Desks & Measuring Lines Home Connection.
Lesson Twenty: Shopping for Toy Store Problems, Part 2 In this last session of the unit, students showcase their communication and problem solving skills by continuing to solve problems posted in the room. As students complete their work, they go to Work Places.

Interdisciplinary / Real World / Global Connections
• In this unit ants and insects are used to teach measurement, fractions and multi-digit addition and subtraction in order to tap into students' natural interest while providing a real-world connection. • This unit builds on the learning in Unit 4 involving customary units of measurement extending to the metric system. This provides students with the opportunity to compare and contrast the two different measurement systems.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☐ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☒ Socially Aware
☐ Responsibly Making Decisions

Differentiation
Challenge: ● Ask students to create their own version of a work place and teach another pair of students how to play ● See "Game Variations" in work place guides ● See "Assessment and Differentiation" in work place teacher masters
Support: ● When applicable give students smaller numbers to practice the strategies ● When working with larger numbers, give students the addition/subtraction charts to support basic fact recall ● See "Game Variations" in work place guides ● See "Assessment and Differentiation" in work place teacher masters
MLL (Multilingual Learners)**:** ● Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language. ● Pre-teach vocabulary in ways that connect to students' prior knowledge. ● Display posters of graphic representations of vocabulary words. ● Provide support to assist in explaining thinking with sentence starters and work banks. ● Use Work Place Sentence Frames or other sentence frames to assist students in math discourse. ● Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea.

Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.

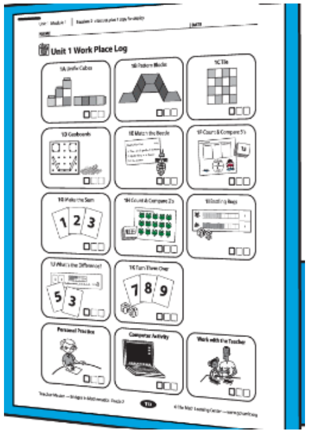
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

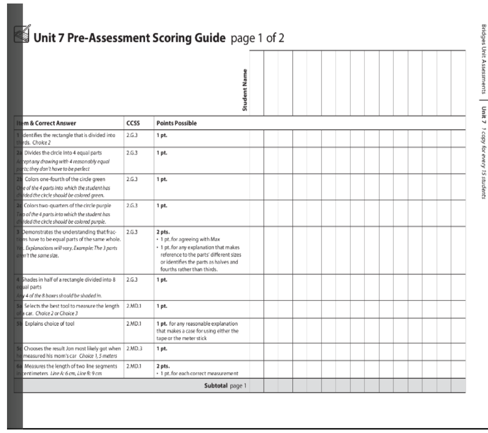
Assessments

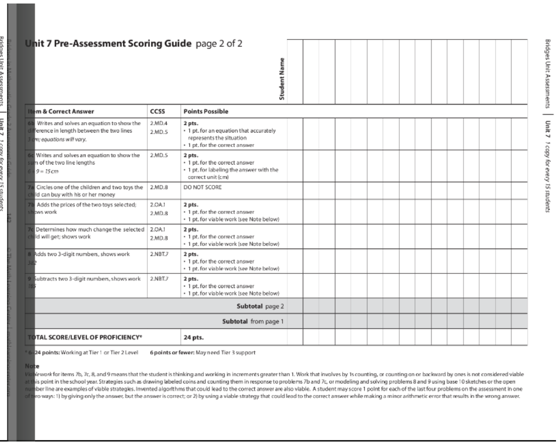
Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 7 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work
- Problem Strings







Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Metric Measuring and Fractions Checkpoint

Metric Measuring & Fractions Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name										
1 Identifies the rectangle that is divided into thirds. *Choice 2*	2.G.3	**1 pt.**											
2a Divides the square into 4 equal parts *Accept any drawing with 4 reasonably equal parts; they don't have to be perfect*	2.G.3	**1 pt.**											
2b Colors one-fourth of the square red *One of the 4 parts into which the student has divided the square should be colored red.*	2.G.3	**1 pt.**											
2c Colors three-quarters of the square blue *Three of the 4 parts into which the student has divided the square should be colored blue.*	2.G.3	**1 pt.**											
3a Identifies the part of a pizza DJ should choose. *Any of the three choices is acceptable.*	2.G.3	DO NOT SCORE											
3b Justifies why DJ should choose that part. *Responses will vary.*	2.G.3	**1 pt.** for any explanation that makes sense in terms of the part selected in 3a.											
4 Selects the best tool to measure the length of a crayon. *Choice 1: army ant ruler*	2.MD.1	**1 pt.**											
5 Identifies the best unit of measure for finding the length of a school bus. *Choice 2: meters*	2.MD.1	**1 pt.**											
6a Estimates length to choose the line segment that looks longer. *Line A*	2.MD.3	**1 pt.**											
6b Measures the length of two line segments in centimeters *Line A: 10 cm; Line B: 8 cm*	2.MD.1	**2 pts.** • 1 pt. for each correct measurement											
6c Tells which of the two lines is longer. *Line A*	2.MD.4	**1 pt.**											
6d Finds the difference between the lengths of the two line segments; shows work. *Line A is 2 cm longer than Line B.*	2.MD.4	**2 pts.** • 1 pt. for the correct answer • 1 pt. for showing viable work											
TOTAL SCORE/LEVEL OF PROFICIENCY*		**13 pts.**											

* **Meeting Standard:** 10–13 points (75%–100% correct) **Approaching Standard:** 7–9 points (50–74% correct) **Strategic:** 4–6 points (25–49% correct) **Intensive:** 3 points or less

- Unit 7 Post-Assessment

Unit 7 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name			
1 Identifies the rectangle that is divided into thirds *Choice 2*	2.G.3	**1 pt.**				
2a Divides the circle into 4 equal parts *Accept any drawing with 4 reasonably equal parts; they don't have to be perfect*	2.G.3	**1 pt.**				
2b Colors one-fourth of the circle green *One of the 4 parts into which the student has divided the circle should be colored green.*	2.G.3	**1 pt.**				
2c Colors two-quarters of the circle purple *Two of the 4 parts into which the student has divided the circle should be colored purple.*	2.G.3	**1 pt.**				
3 Demonstrates the understanding that fractions have to be equal parts of the same whole *Yes. Explanations will vary. Example: The 3 parts aren't the same size.*	2.G.3	**2 pts.** • 1 pt. for agreeing with Max • 1 pt. for any explanation that makes reference to the parts' different sizes or identifies the parts as halves and fourths rather than thirds.				
4 Shades in half of a rectangle divided into 8 equal parts *Any 4 of the 8 boxes should be shaded in.*	2.G.3	**1 pt.**				
5a Selects the best tool to measure the length of a car. *Choice 2 or Choice 3*	2.MD.1	**1 pt.**				
5b Explains choice of tool	2.MD.1	**1 pt.** for any reasonable explanation that makes a case for using either the tape or the meter stick				
5c Choose the result Jon most likely got when he measured his mom's car *Choice 1, 5 meters*	2.MD.3	**1 pt.**				
6a Measures the length of two line segments in centimeters *Line A: 6 cm, Line B: 9 cm*	2.MD.1	**2 pts.** • 1 pt. for each correct measurement				
		Subtotal page 1				

Unit 7 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name										
6b Writes and solves an equation to show the difference in length between the two lines *3 cm; equations will vary.*	2.MD.4 2.MD.5	**2 pts.** • 1 pt. for an equation that accurately represents the situation • 1 pt. for the correct answer											
6c Writes and solves an equation to show the sum of the two line lengths *6 + 9 = 15 cm*	2.MD.5	**2 pts.** • 1 pt. for the correct answer • 1 pt. for labeling the answer with the correct unit (cm)											
7a Circles one of the children and two toys the child can buy with his or her money	2.MD.8	DO NOT SCORE											
7b Adds the prices of the two toys selected; shows work	2.OA.1 2.MD.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see Note below)											
7c Determines how much change the selected child will get; shows work	2.OA.1 2.MD.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see Note below)											
8 Adds two 3-digit numbers, shows work *382*	2.NBT.7	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see Note below)											
9 Subtracts two 3-digit numbers, shows work *185*	2.NBT.7	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see Note below)											
		Subtotal page 2											
		Subtotal from page 1											
TOTAL SCORE/LEVEL OF PROFICIENCY*		**24 pts.**											

* **Meeting Standard** 18–24 points (75%–100% correct) **Approaching Standard** 12–17 points (50–74% correct) **Strategic** 6–11 points (25–49% correct) **Intensive** 5 points or less (2

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 2

Subject(s)	Mathematics
Grade/Course	Grade 2 / Mathematics
Unit of Study	Unit 8: Measurement, Data and Multi-Digit Computation with Marble Rolls
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:
2.MP.1 Make sense of problems and persevere in solving them.
2.MP.2 Reason abstractly and quantitatively.
2.MP.3 Construct viable arguments and critique the reasoning of others.
2.MP.4 Model with mathematics.
2.MP.5 Use appropriate tools strategically.
2.MP.6 Attend to precision.
2.MP.7 Look for and make use of structure.
2.MP.8 Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
Supporting Standards:
2.NBT.A.1 Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones.
2.NBT.A.2 Count within 1000; skip-count by 5s, 10s, and 100s.
2.NBT.A.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.

2.NBT.A.4 Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons.
2.NBT.B.7 Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones, and ones; and sometimes it is necessary to compose or decompose tens or hundreds.
2.NBT.B.9 Explain why addition and subtraction strategies work, using place value and the properties of operations.
2.NBT.B.8 Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.

Supporting Standards:
2.MD.B.5 Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.
2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2.MD.A.3 Estimate lengths using units of inches, feet, centimeters, and meters.
2.MD.D.9 Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units.
2.MD.B.6 Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, and represent whole-number sums and differences within 100 on a number line diagram.
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simply put-together, take-apart, and compare problems using information presented in a bar graph.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Demonstrate that the digits in a three-digit number represent the amounts of hundreds, tens, and ones.	1. The position of the digits 0-9 in a number determines their value.

2. Skip-count by 10s and 100s up to 1000.	2. Patterns through 100 in our number system can be extended to larger numbers.
3. Read and write numbers to 1000 represented with numerals, words, and expanded form.	3. 3-digit numbers are made of hundreds, tens, and ones.
4. Compare pairs of 3-digit numbers, based on an understanding of what the digits in their hundreds, tens, and ones places represent and use >, =, and < symbols to record comparisons of two 3-digit numbers.	4. The symbols >, < and = are used to explain a number's magnitude in comparison to another.
5. Use concrete models or drawings to add and subtract with sums and minuends to 1000.	5. Base-ten blocks and place value chips can be used to model the action of adding and subtracting numbers.
6. Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to add and subtract with sums and minuends to 1000.	6. Addition and subtraction strategies for sums and minuends to 100 can be extended to larger numbers.
7. Use written numbers and symbols to represent strategies for adding and subtracting with sums and minuends to 1000.	7. Equations are written with numbers and operations to show how numbers can be composed and decomposed to create equal quantities.
8. Add with sums to 1000 using strategies that involve adding hundreds to hundreds, tens to tens, and ones to ones.	8. When adding multi-digit numbers, it is important to add like place values.; hundreds to hundreds, tens to tens and ones to ones.
9. Subtract with minuends to 1000 using strategies that involve subtracting hundreds from hundreds, tens from tens, and ones from ones.	9. When subtracting multi-digit numbers, it is important to subtract from place values; hundreds from hundred, tens from tens and ones from ones.
10. Add with sums to 1000 using strategies that involve composing a hundred or a ten.	10. When adding, if the result yields more than ten ones, a new ten is made; if the result yields more than ten tens, a

	new hundred is made.
11. Select and use the appropriate tool for measuring the length of an object.	11. There are multiple tools available to measure the length of an object or distance.
12. Measure the length of an object in inches using rulers, yardsticks, and measuring tapes.	12. When measuring length, the tool must be placed from end to end without gaps or overlaps.
13. Estimate length in inches and feet.	13. We can use benchmarks to help us make approximations of how long an object or distance is.
14. Determine exactly how much longer one object is than another and express the difference between the two lengths in terms of a standard unit of length.	14. We can use subtraction to determine how much longer or shorter one object or distance is than another.
15. Solve subtraction story problems with minuends to 100 involving lengths given in the same units.	15. Strategies for subtracting whole numbers apply to situations involving subtracting lengths with the same units.
16. Make a line plot to show measurement data, with a horizontal scale marked in whole number units.	16. A number line can be used to represent the frequency of data in a line plot.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why is the design process important when developing and implementing an idea or prototype?	1. The design process (define, ideate, prototype, test) can be applied to work through and solve any type of problem. Students can go through these steps to create, test and refine their marble runs and then return to this process when future problems arise.
2. How are math and science related?	2. Through the implementation of the scientific method and

	the design process for engineering, students get real-world applications of addition and subtraction, measurement, and data collection and analysis. The two disciplines cannot be isolated.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.4.a** Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems. **Standard 1.4.b** Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
Books/Media: ● Measurement Books ● Twelve Snails and One Lizard **Online Resources / Websites:** ● Create A Graph ● Teacher Tool: Marble Machines

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Bar graph:** a graph using vertical or horizontal bars to show how large specific values are. **Centimeter (cm):** a metric unit of length equal to 1/100 of a meter or about ⅖ of an inch. **Compare:** to examine to note similarities and differences; to determine whether numbers are greater than, less than or equal. **Data:** items of information; may include facts, numbers, or measurements. **Difference:** the result of subtracting one number from another; the amount by which one number is greater or less than another

number.
Digit: any one of the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9.
Equation: a mathematical statement asserting that two quantities have the same value.
Foot (ft.): a customary unit of length equal to twelve inches.
Greater than: a symbol, >, used to indicate that the number on the left is greater than the number on the right.
Height: how tall something is; the measurement from top to bottom of an object or a shape.
Hundreds: the numbers 100 to 999; also refers to the hundreds place.
Inch (in.): a customary unit of length equal to 1/12 a foot.
Length: how long something is.
Less than: a symbol, <, used to indicate that the number on the left is less than the number on the right.
Line plot: a horizontal number line that uses markings (such as an X or a dot) to show data points above their values on the line.
Meter (m): a metric unit of length equal to 100 centimeters or about 39 inches.
Ones: the numbers 0-9; also refers to the ones place.
Sum or total: the result of adding two or more numbers.
Tens: the numbers 10-99; also refers to the tens place.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

This unit provides a review of place value and three-digit computation in Week 1. Weeks 2, 3, and 4 focus on data collection and analysis. In Week 2, students are introduced to a project in which they make cardboard ramps of different kinds to investigate some of the factors that cause marbles to roll farther and faster. After their initial explorations, students conduct formal experiments to test several different variables. In the process, they generate data by measuring marble roll distances multiple times, pool their data, and enter it on line plots to better see, understand, and analyze how manipulating the different variables affects the outcomes. The unit concludes with student-conducted surveys, in which students generate questions on topics of their choosing, gather, organize, and analyze the data, and share their findings with others.

Learning Tasks Per Week (Including Instructional Strategies)

Week One: Revisiting Place Value & Three-Digit Computation
The first week reviews place value through and beyond 1,000, as well as 3-digit addition and subtraction. Students have an opportunity to deepen their understanding, correct misconceptions, solidify strategies for dealing with 3-digit addition and

subtraction problems, and develop new methods of approaching these situations. Two new Work Places, Sum It Up and Roll & Subtract One Thousand, present skill practice in the form of games. **Lesson One:** Target Seven Hundred The first lesson of Unit 8 opens with a new game, Target Seven Hundred. Target Seven Hundred is designed to provide students with opportunities to develop deeper understandings of 3-digit numbers by building them with base ten area pieces. The quantities collected by each team are compared to 700 and differences are calculated to determine which number is closer to the target.
Lesson Two: Unit 8 Pre-Assessment During the first half of the session, students take the Unit 8 Pre-Assessment. When most students are finished with the assessment, the teacher reconvenes the class and conducts an activity designed to review place value through 999 and then move ahead into the thousands.
Lesson Three: Solving Story Problems Today students solve several 3-digit addition problems, two of which are set in the context of finding a total distance or a total length. As students solve each problem, the teacher circulates to watch the strategies they are using and selects two or three individuals to share and explain their methods. The class locates each strategy on the posters on display from the previous unit. If a new strategy comes up, students and teachers work together to make a new poster.
Lesson Four: Introducing Work Place 8A Sum It Up The teacher introduces Work Place 8A Sum It Up. In the game, players take turns rolling random numbers and deciding after each roll what place value to assign to that number. After six rolls, each player has two 3-digit numbers, which they add together to try to get either the smallest or largest sum. After playing against the teacher, students work in pairs to play. At the end of the session, students go out to Work Places. Introducing Work Place 8A Sum It Up: Players take turns rolling random numbers and deciding after each roll what place value to assign to that number. After six rolls, each player has two 3-digit numbers, which they add together to try to get either the smallest or largest sum.
Lesson Five: Larger Numbers on a Line In this session, students use the open number line to model and solve three subtraction story problems, all of which involve some form of comparing. They work the first problem as a whole group, the second with a partner, and the third independently. When they finish the last problem, they get their folders and go to Work Places.
Lesson Six: Roll & Subtract One Thousand

Students play another new game, Roll & Subtract One Thousand, against the teacher today. In the game, the class and the teacher take turns rolling three dice numbered 1–6, arranging the numbers rolled to form 3-digit numbers, and subtracting those numbers from 1,000. After three turns, the team with the non-negative score closer to 0 wins. Students play the game twice with the teacher, and then the game is added to the current collection of Work Places. Introducing Work Place 8B Roll & Subtract One Thousand: Each player takes a turn to roll three dice, arrange the numerals rolled to make a 3-digit number, and subtract the number from 1,000. After that, each player gets two more turns to roll, arrange, and subtract. The player who scores closer to zero (without going past zero into negative numbers) after three turns wins.
Week Two: Building Marble Rolls & Collecting Data This week introduces materials students will use over the next couple of weeks: marbles, cardboard tubes, unit blocks, masking tape, and tape measures. As a result of their explorations and observations over the first three sessions, students generate a set of hypotheses about the variables that affect the speed and distance of marble rolls. In Sessions 4 and 5, they conduct an experiment to determine the effect of raising the height of the ramp from which a marble is launched. They set up the experiment to control for all but one variable, collect measurement data, plot the data on a line plot, and analyze the data to determine whether it supports their original hypotheses. **Lesson Seven:** Exploring Marbles & Ramps During this session, the teacher introduces the materials and basic problems students will explore over the next several sessions: using blocks, tape, and cardboard tubes, can you get a marble to move without pushing it?
Lesson Eight: Introducing Longer Tubes The teacher introduces a new variable—ramp length—by providing each student pair with one or two tubes that are considerably longer than paper towel tubes to use in addition to the materials in their baskets. Students discuss and make hypotheses about the effects of the longer tube. Then students go back out in pairs to test their ideas and continue to build marble rolls.
Lesson Nine: Introducing Marbles That Differ in Mass This is the third and last day of free exploration. The teacher introduces two new materials that should spark some new thinking. The first is marbles of differing mass. Now, in addition to a glass marble, each pair of students has a steel ball and a round wooden ball, all the same size but quite different in mass. The second is colored tiles, dominoes, or lightweight blocks that are set up at the end of marble rollways as “targets” to be knocked over as the marbles speed along.
Lesson Ten: Marble Roll Experiment 1: Ramp Height As students explored marble ramps and pathways over the last several sessions, they generated hypotheses about different factors

that appear to affect the marble's roll, including ramp height, ramp length, and marble mass. This session is the first of several in which students test their hypotheses by conducting formal experiments, collecting data, and analyzing the results. After the teacher introduces the procedure, students work in pairs to conduct three trials for each ramp height, measuring and recording the distance the marble rolls each time.
Lesson Eleven: Plotting & Analyzing the Ramp Height Data Students combine the data they collected during the previous session to create and discuss a class line plot on the board. After discussing the data display, each student copies the line plot into his or her Student Book and completes a set of related questions.
Week Three: Collecting & Analyzing More Marble Roll Data Students conduct experiments to test two other variables that may or may not affect the marble's speed and distance, then pool and analyze the data. After taking the Unit 8 Post-Assessment in Session 5, they apply and extend the results of their experiments to design rollways that will enable marbles to perform specified tasks. During a final, extended session, students can build the marble rolls they designed, modify them as needed, and then share them with their classmates. **Lesson Twelve:** Marble Roll Experiment 2: Marble Mass In this session, students conduct a second marble roll experiment, this time to see whether the mass of the marble affects its speed and distance, and if so, how. After the teacher introduces the procedure, students work in pairs to conduct three trials each for three marbles of different masses, measuring and recording the distance the marble rolls each time. Students who finish before the end of the session get their folders and go to Work Places.
Lesson Thirteen: Plotting & Analyzing the Marble Mass Data Students combine the data they collected during the previous session to create and discuss a class line plot on the board. After discussing the data display, each student copies the line plot onto a worksheet and completes a set of related questions in his or her Student Book.
Lesson Fourteen: Marble Roll Experiment 3: Ramp Length In this session, students conduct a third and final marble roll experiment, this time to see whether the length of the ramp affects the speed and distance rolled by the marble, and if so, how. After the teacher introduces the procedure, students work in pairs to conduct three trials each for three different ramp lengths, measuring and recording the distance the marble rolls each time. Students who finish before the end of the session get their folders and go to Work Places.
Lesson Fifteen: Plotting & Analyzing the Ramp Length Data Students combine the data they collected during the previous session to create and discuss a class line plot on the board. After

discussing the data display, each student copies the line plot onto a worksheet and completes a set of related questions in his or her Student Book.
Lesson Sixteen: Designing Mega-Marble Rolls Students complete the Unit 8 Post-Assessment during the first part of the session. Then the teacher reconvenes the class to discuss and get started on the final marble roll task—designing and building marble rolls that perform specific tasks, such as rolling uphill, turning corners, or knocking over targets. Pairs then start working on a written plan for their marble rolls, including a list of materials they will need.
Lesson Seventeen: Building Mega-Marble Rolls Students use their plans from Session 5 to build marble rolls and test them to see if they complete the tasks assigned. If modifications are necessary to get the marbles to perform specified "tricks," students make them right on the spot. When they're finished, they make drawings of their final marble rolls. Photographs may also be taken to record their final work.
Week Four: Student-Conducted Surveys: As Unit 8 winds to a close, students are given the opportunity to conduct their own surveys. They generate a survey question and 2–4 response choices, as well as collect, organize, graph, analyze, and share the data about something of particular interest to them. **Lesson Eighteen:** Find Someone Who… Today's session sets the stage for student surveys as students practice asking their classmates questions.
Lesson Nineteen: Collecting the Data Today students each devise a survey question, complete a planning sheet, and then conduct their survey in the classroom. They are allowed to collect and organize the data in the way that makes best sense to them
Lesson Twenty: Graphing & Analyzing the Data In this final session, students create bar graphs to display the data they collected in the previous session, and then complete a related sheet in their Student Books.

Interdisciplinary / Real World / Global Connections

- This unit provides opportunities for students to collect and analyze data through designing and testing different ramps for marbles. This real-world context gives students practice with previously learned measurement concepts.
- The design process through which students build different ramps supports second grade NGSS when students think about how different variables affect outcomes, collect data, and represent data in different types of graphs.

Science Skills Addressed	
Content Standard A: Science as Inquiry	Plan and conduct a simple investigation (2.NSES.A.1.2)
	Employ simple equipment and tools to gather data and extend the senses (2.NSES.A.1.3)
	Use data to construct a reasonable explanation (2.NSES.A.1.4)
	Communicate investigations and explanations (2.NSES.A.1.5)
Content Standard B: Physical Science	Demonstrate the understanding that objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances, and thermometers (2.NSES.B.1.1)
	Demonstrate an understanding that the position of an object can be described by locating it relative to another object or the background (2.NSES.B.2.1)
	Demonstrate an understanding that an object's motion can be described by tracing and measuring its position over time (2.NSES.B.2.2)
	Demonstrate an understanding that the position and motion of objects can be changed by pushing or pulling, and that the size of the change is related to the strength of the push or pull (2.NSES.B.2.3)
Content Standard E: Science and Technology	Identify a simple problem (2.NSES.E.1.1)
	Propose a solution (2.NSES.E.1.2)
	Recognize that designing a solution might have constraints, such as cost, materials time, space, or safety (2.NSES.E.1.2)
	Implement proposed solutions (2.NSES.E.1.3)
	Evaluate a product or design (2.NSES.E.1.4)
	Communicate a problem, design, and solution (2.NSES.E.1.5)

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☐ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- As students complete their marble designs ask students how they would change the design based on different variables to challenge them.

> **Marble Roll Problem 5**
> Make a marble roll that gets the marble to go down, then up, then down, then into a target made of 25 dominoes or plastic tiles. The target must start 3 or more inches from the end of the marble roll.

- Ask students to create their own version of a work place and teach another pair of students how to play
- See “Game Variations” in work place guides
- See “Assessment and Differentiation” in work place teacher masters

Support:

- When applicable give students smaller numbers to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- See “Game Variations” in work place guides
- See “Assessment and Differentiation” in work place teacher masters

MLL (Multilingual Learners)**:**

- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students’ prior knowledge.
- Display posters of graphic representations of vocabulary words.
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play in a work place so that other students can offer

step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 8 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work
- Problem Strings

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 8 Post-Assessment

Unit 8 Post-Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Writes a 3-digit number in expanded form *300 + 9*	2.NBT.3	**1 pt.**	
1b Writes a 3-digit number in words *five hundred twenty eight*	2.NBT.3	**1 pt.**	
1c Write a 3-digit number in standard form *914*	2.NBT.3	**1 pt.**	
2 Uses symbols to compare 3-digit numbers *203 < 230, 813 > 785, 451 = 415, 987 > 978*	2.NBT.4	**2 pts.** • half a point for each correct response	
3 Agrees or disagrees with a prediction about the experiment and tells why	2.MP.3	**1 pt.** for any reasonable explanation, regardless of whether the student agrees or disagrees with the prediction	
4a Lists 10 data points in order *27" 27" 28" 28" 29" 29" 29" 29" 29" 30"*	2.MD.9	**1 pt.**	
4b Enters 10 data points on a line plot correctly	2.MD.9	**5 pts.** • half a point for each data point entered correctly on the line plot	
4c Uses data on a line plot to support a conclusion about an experiment *Yes. Explanations will vary. Example: The longest roll from the short ramp was 14 inches. The shortest roll from the higher ramp was 27 inches.*	2.MD.9	**2 pts.** • 1 for a *Yes* response • 1 for an explanation that makes at least one reference to the data on the line plot	
5 Adds two 3-digit numbers, shows work *625*	2.NBT.7	**2 pts.** • 1 for the correct answer • 1 pt. for viable work (see Note below)	
6 Subtracts two 3-digit numbers, shows work *158*	2.NBT.7	**2 pts.** • 1 for the correct answer • 1 pt. for viable work (see Note below)	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**18 pts.**	

* **Meeting Standard:** 14–18 points (75%–100% correct) **Approaching Standard:** 9–13 points (50–74% correct) **Strategic:** 5–8 points (25–49% correct) **Intensive:** 4 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 1: Addition and Subtraction Patterns
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** 1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. Construct viable arguments and critique reasoning of others. 4. **Model with mathematics.** 5. Use appropriate tools strategically. 6. Attend to precision. 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.** **Priority/Focus Standards:** **3.OA.8** Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. **3.OA.9** Identify patterns among basic addition and subtraction facts and explain those patterns by referring to properties by referring

to properties of the operation.
3.NBT.2 Use strategies based on place value, properties of operations, or the relationship between addition and subtraction to add fluently with sums to 1,000 or to fluently subtract with minuends to 1,000.

Supporting Standards:

2.OA.1 Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
2.OA.2 Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers.
2.NBT.5 Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Fluently add and subtract within 20 using mental strategies.	1. Addition and subtraction facts to 20.
1. Solve one-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions.	2. Problem structures for addition and subtraction.
2. Fluently add and subtract within 100 using strategies based on place value.	3. Numbers can be composed and decomposed into tens and ones to add to or subtract from another number.
3. Fluently add and subtract within 100 using strategies based on properties of addition and subtraction and/or the relationship between addition and subtraction.	4. Addition is a commutative property; subtraction is not commutative. Addition and subtraction are inverse operations.

4. Identify patterns among basic addition and subtraction facts.	5. Identify patterns in shapes, colors, and basic number patterns.
5. Add and subtract within 1,000 using strategies and algorithms based on place value.	6. Numbers can be composed and decomposed into hundreds, tens, and ones in order to add to or subtract from another number.
6. Add and subtract within 1,000 using strategies and algorithms based on properties of operations, and/or the relationship between addition and subtraction.	7. Addition is a commutative property; subtraction is not commutative. Addition and subtraction are inverse operations.
7. Recall from memory all sums of two 1-digit numbers.	8. Basic addition and subtraction facts within 20.
8. Skip count by 10's.	9. Add and subtract ten to any number within 1,000.
9. Measure the length of an object to the nearest whole centimeter using a ruler and measuring tape.	10. Length can be measured in centimeters by using a ruler/meter stick and can be rounded to the nearest whole number either starting from 0 and reading the whole number closest to the end of the object, or by finding the difference between the 2 whole numbers on a ruler when starting from a number other than zero.
10. Estimate length in centimeters.	11. An estimate is an educated guess where actual measurements can be either greater or less than the number estimated.
11. Solve two-step story problems using addition and subtraction.	12. Problem structures for addition and subtraction; addition and subtraction strategies within 1,000.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why is it important to be able to add and subtract whole numbers?	1. Addition and subtraction facts retrieval is more likely to be efficient and successful when based on models, use of

2. Can numbers be composed and decomposed in more than one way?	strategies, and intuition, as opposed to rote memorization and recall. 2. Part-part-whole understanding is fundamental to a rich understanding of numbers and understanding addition and subtraction as operations.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

1.1.c Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

Books / Media:

- **Media:**
  - MLC Pinterest board for addition and subtraction

Online Resources / Websites:
MLC Apps:

- Number Rack App
- Number Line App

Games:

- Deep Sea Duel
- Math Madness
- Number Facts Bingo
- Reflex Math

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Associative Property of Addition: the property by which the sums remain the same no matter how the numbers being added are grouped, so that (a + b) + c = a + (b + c).
Centimeter (cm): a metric unit of length that is equal to 1/100 of a meter and about ⅖ of an inch.
Commutative Property of Addition: the property by which the sum remains unchanged no matter how the numbers being added are ordered, so that a + b = b + a.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Even Number: a number that can exactly be divided by 2; all even numbers end with 0, 2, 4, 6, or 8.
Inch (in.): a customary unit of length equal to 1/12 of a foot.
Number Line: a diagram in which numbers are represented as points on a number line.
Odd Number: a number that cannot exactly be divided by 2; all even numbers end with 1, 3, 5, 7, 9.
Sum or Total: the result of adding two or more numbers.

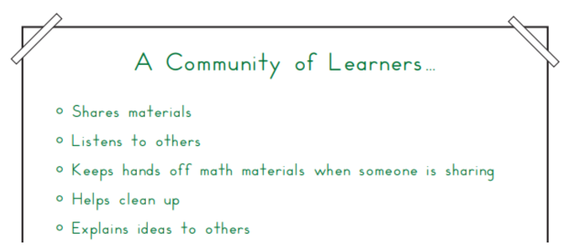
Learning Plan

Overview and Key Learning Events and Instruction Per Week

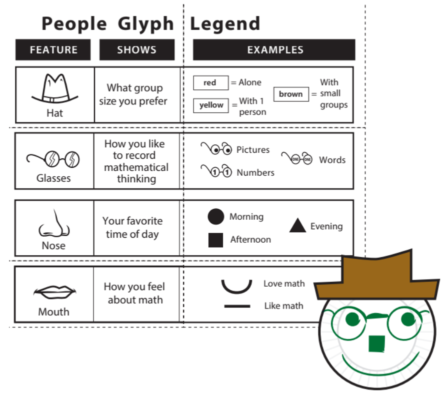
This unit focuses on patterns in addition and subtraction facts, the pattern of adding 10s, measuring, and problem solving. The first module sets the tone for the year with community building and then reviews the addition strategies for facts to 20, which students learned in second grade. The second module revisits subtraction strategies for facts to 20. Students are introduced to multi-digit addition on the open number line in Module 3, and Module 4 presents students with a collection of story problems that prompt them to practice their skills with multi-digit addition and subtraction.

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: Week 1 focuses on building a community of learners, setting the tone for math class for the rest of the year. Students build People Glyphs to share with classmates their preferred learning styles in math. They sort and classify the glyphs and collect the data in a bar graph. Students complete the addition table to review basic addition facts and discuss patterns among them in terms of properties of the operation of addition.



Create “A Community of Learners” class chart/agreement:
Ask students to think, pair, share ideas for guidelines for how members of a learning community should act. Use this anchor chart throughout the year adding/editing as the learning community’s needs change.

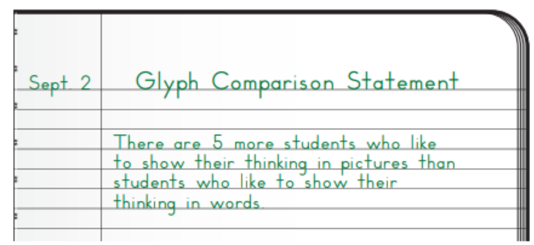


Make People Glyphs:
Define a glyph (from Egyptian hieroglyphics) as a picture whose features represent information about a given subject based on a specific Glyph Legend.

Students make glyphs based on the People Glyph Legend.

Students use completed glyphs to sort them in different ways.

Introduce student math journals which provide a place for students to record their work, questions, reflections, and notes. Teacher models a “Glyph Comparison Statement” journal entry.



Have students copy the statement in their journals and highlight the key features of a comparison statement.

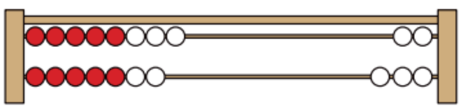
- Ask students to identify the two groups that are being compared in the sentence.
- Underline each phrase that identifies those two groups, and have students do the same in their journals.
- Circle the word "than," because it shows that you have made a comparison between the two groups.
- Have students do the same in their journals.

You might extend students' work with comparisons by showing how to use the <, =, and > symbols, which were introduced in earlier grades.

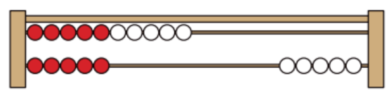
Use the data set from the comparison statement to create a class bar graph of the results.

Administer Unit 1 pre-assessment.

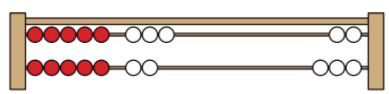
Revisit the Number Rack:
This model was used throughout second grade. Review the structure of the rack, 2 bars of 10 beads grouped in 5 red and 5 white. Then use the rack to discuss strategies for solving various addition problems beginning with 8+7. Repeat with the following number combinations: 5+6, 7+7, 6+8. 9+9, 4+5, 8+3, 7+8.



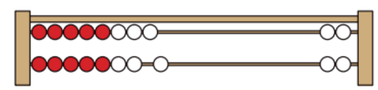
Student *I'd move 2 beads over on top next to the 8, and move 2 beads away on the bottom away from the 7. Now you have 10 on the top and 5 on the bottom. So 8 + 7 is 15.*



Student *If you barely slide the 3 white beads away from the 5 red beads on the top, and barely slide the 2 white beads away from the 5 red beads on the bottom, you can see 10 red beads and 5 white beads. That's 15.*



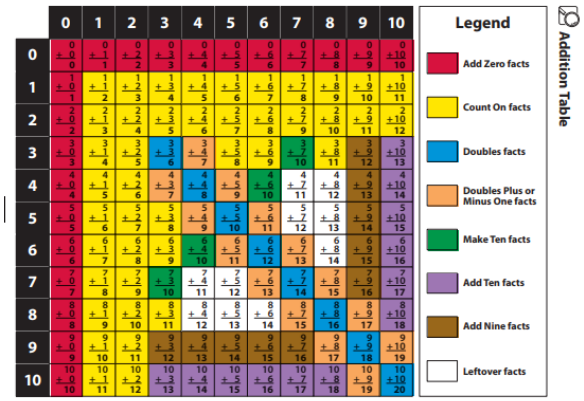
Student *If you move 1 more white bead over on the bottom, you have 8 + 8 and I know that's 16. So 8 + 7 is 1 less, 15.*



Have students explain in their math journals how they would use the math rack to solve 6+7. Use the following prompt: "How would you explain to a friend how to solve 6+7 using a number rack? Draw a picture of the math rack to support your explanation."

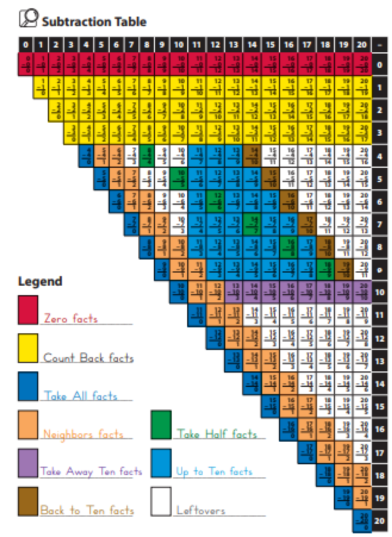
Use the addition table to review addition strategies:
Identify and color code these facts on the addition table: Add zero facts, Count on facts (+1, +2, +3), Doubles facts, Doubles +/- 1 facts, Make 10 facts, Add Ten facts, Add Nine facts, Leftover facts.

Use the math rack to create a visual model of these strategies. Encourage student discourse and allow students to explain and give examples of these strategies whenever possible.



Week 2 is devoted to reviewing and exploring subtraction facts. Students use a subtraction table to identify types of facts and to learn and revisit effective and efficient strategies for these facts. They generalize about the number relationships in groups of related facts to develop number sense and fact fluency. They also develop algebraic thinking as they look for patterns and relationships and determine unknown quantities on both sides of the equal sign in an equation. The teacher continues to lay foundations for learning and teaching by working with students on the routines they will use all year, including those for Work Place activities.

Use the subtraction table to review 9 subtraction strategies:
Identify and color code these facts on the subtraction table: Zero facts, Count Back facts, Take All facts, Neighbor facts, Take Away Ten facts, Back to Ten facts, Take Half facts, Up to Ten facts, and Leftovers.



Use the math rack to create a visual model of these strategies. Encourage student discourse and allow students to explain and give examples of these strategies whenever possible.

Discuss the “Leftover Facts” and break them up into smaller groups. Ask students to look for facts that can be solved using the same strategies.

Categories of Leftover Subtraction Facts

Keep the Ten, Subtract the Ones				
19 – 4 = 15	18 – 4 = 14	17 – 4 = 13	16 – 4 = 12	15 – 4 = 11
19 – 5 = 14	18 – 5 = 13	17 – 5 = 12	16 – 5 = 11	
19 – 6 = 13	18 – 6 = 12	17 – 6 = 11		
19 – 7 = 12	18 – 7 = 11			
19 – 8 = 11				

Take Away Ten, Subtract the Ones					
19 – 11 = 8	18 – 11 = 7	17 – 11 = 6	16 – 11 = 5	15 – 11 = 4	14 – 11 = 3
19 – 12 = 7	18 – 12 = 6	17 – 12 = 5	16 – 12 = 4	15 – 12 = 3	
19 – 13 = 6	18 – 13 = 5	17 – 13 = 4	16 – 13 = 3		
19 – 14 = 5	18 – 14 = 4	17 – 14 = 3			
19 – 15 = 4	18 – 15 = 3				
19 – 16 = 3					

Up to Twenty	Twenty Take Away Ones	Only Ones
20 – 11 = 9	20 – 4 = 16	9 – 4 = 5
20 – 12 = 8	20 – 5 = 15	9 – 5 = 4
20 – 13 = 7	20 – 6 = 14	9 – 6 = 3
20 – 14 = 6	20 – 7 = 13	8 – 5 = 3
20 – 15 = 5	20 – 8 = 12	7 – 4 = 3
20 – 16 = 4	20 – 9 = 11	
20 – 17 = 3		

Practice using addition strategies by playing *Target 20:*

Students play with partners. Each player selects 5 number cards and chooses 3 cards that will get them closest to a sum of 20. Each student's score is the difference between their sum and 20. The player with the lowest score after 5 rounds wins.

1B Target Twenty Record Sheet

Player 1 ____________________ Player 2 ____________________

For each round of the game, players write an addition equation, their score, and their partner's score.

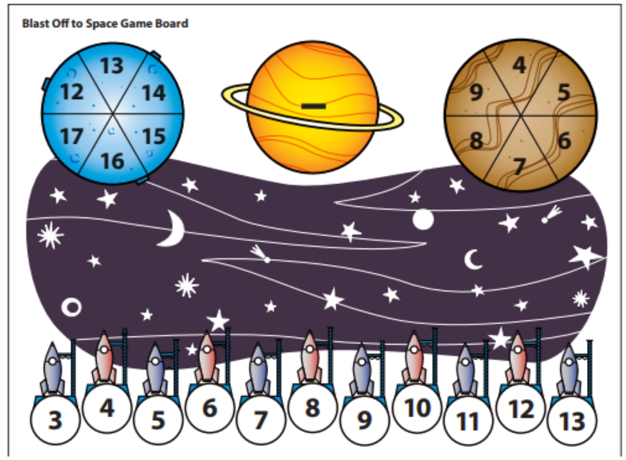
	First Game	My Score	Partner's Score
1	______ + ______ + ______ = ______		
2	______ + ______ + ______ = ______		
3	______ + ______ + ______ = ______		
4	______ + ______ + ______ = ______		
5	______ + ______ + ______ = ______		

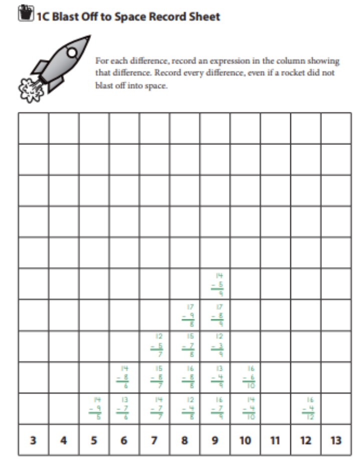
My Final Score: ________ My Partner's Final Score: ________

Administer Addition/Subtraction Checkpoint

Practice using subtraction strategies by playing *Blast Off to Space:*

Players put 8 game markers on the rocket launch pads of the game board. Players take turns spinning each spinner and finding the difference. If they have a game marker on that space, they can launch that rocket and record the equation on the record sheet. Halfway through the game players can reposition their markers based on what they notice on their record sheet. Play continues until one player has blasted off all his/her rockets.





Practice subtraction facts and relational thinking by playing *Subtraction Bingo*:

Relational thinking helps students solve equations such as 5+7=___+8. Introduce students to these types of equations using the number rack as a model. Introduce and play *Subtraction Bingo* teacher vs. class.

On each turn players select 5 number cards. He/she then chooses 2 of those cards whose sum is a 2-digit number and 1 card to subtract from the 2-digit sum. If the difference is 9, that player looks for a subtraction fact on the game board with the same difference. Students record their subtraction facts in the space below the game board.

1D Subtraction Bingo Record Sheet

Player A ____________ Player B ____________

Record problems below the bingo boards.

Board A			
10 – 7	11 – 5	14 – 3	16 – 7
15 – 8	13 – 4	12 – 5	17 – 8
15 – 6	18 – 6	16 – 2	14 – 9
18 – 7	12 – 5	13 – 7	17 – 4

Board B			
17 – 9	11 – 3	16 – 5	15 – 7
18 – 5	14 – 8	13 – 6	12 – 3
13 – 8	16 – 9	15 – 9	11 – 6
18 – 9	17 – 4	14 – 5	12 – 8

Board A Problems

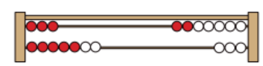
Board B Problems

Begin the session by asking students to consider the following problem, first in pairs and then as a whole class.

12 = ____ + 5

- Gather the class in the discussion area.
- Write the equation where everyone can see it.
- Have students turn to a partner to discuss what number is missing from the equation.
- Invite a few pairs to share their thinking with the group.

Then write the next equation where everyone can see and ask students to think quietly about it while you model 3 + 7 on the number rack as shown.

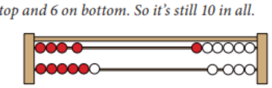


3 + 7 = 6 + ___

Slide 1 bead away from the 7 and ask students what you should do to the top row to keep the total number of beads the same. Model their ideas on the number rack and complete the equation with their input.

Students *You have to add 1 more to the top. So instead of 3, it should be 4 on top.*

Yup, 4 on top and 6 on bottom. So it's still 10 in all.



3 + 7 = 6 + <u>4</u>

Week 3 begins with a measurement context in which students search out objects that have certain lengths. The class uses these measurements to build the open number line and then uses the open number line to model students' strategies to add double-digit length measurements. The class has their first math forum, to encourage students toward more efficient and sophisticated addition strategies. Students learn a game, Carrot Grab, that helps them with place-value patterns and the addition strategy of getting to a friendly number. As they work on double-digit addition, they are also inherently developing algebraic thinking as they look for patterns and relationships and determine unknown quantities on both sides of the equal sign.

Introduce the count-around routine:
Count around the room by 10s beginning with 8. Have students write the numbers and stop to discuss patterns and strategies after every 5 or so numbers. Once at 108, 118, etc. continue to discuss groups of tens and ones, not hundreds. Complete a similar count-around at the beginning of each session this week.

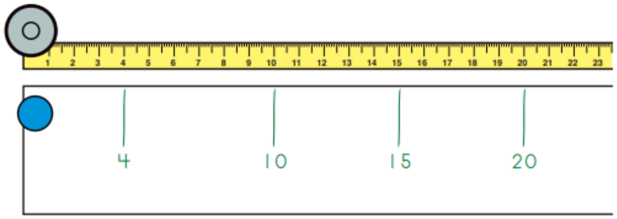
Conduct a lengths scavenger hunt:
Review centimeters as a unit of length and how rulers and tape measures can be used to measure length in centimeters. Have students work in partners to find items in the classroom that match the lengths you identify on the whiteboard.

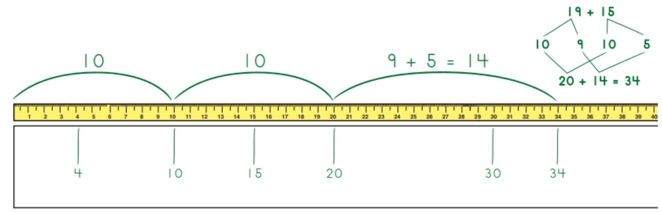
Create a measurement comparison chart:
Using students' measurements from the scavenger hunt, create an open number line on adding machine tape to show the different lengths of the objects they found. Use this model to solve various adding lengths problems such as "How long are the pencil and the white board eraser when placed together end-to-end?" Model students' thinking above the adding machine tape. Make the explicit connection between the open number line model and length measurement.

Students will be measuring objects around your room to find certain lengths. Before you teach this session, find 10 objects in your classroom that either match or approximate the measurements listed below:

- 4 centimeters (e.g., pen lid, small sticky note)
- 15 centimeters (e.g., pen, marker, board eraser)
- 19 centimeters (e.g., unsharpened pencil)
- 28 centimeters (e.g., piece of paper)
- 51 centimeters (e.g., seat depth of chair, height between two bookcase shelves)
- 76 centimeters (e.g., width of a door)
- 95 centimeters (e.g., teacher desk depth)
- 120 centimeters (e.g., height of a chair back)
- 145 centimeters (e.g., height of shelves, height of filing cabinet)
- 203 centimeters (e.g., height of a door)

When you have identified the objects you plan to use, list the exact measurement of each on the board for students to use in the scavenger hunt. Just list the measurement of each object, not the name of the object.





Use this opportunity to model writing equations in different ways and how each equation matches the adding length problems.
example: 19 + 15= m; 19 + m = 34; m + 15= 34
Then write an incorrect equation and discuss whether it matches the problem: 19 - 15 = m

Students work on various adding length problems independently while you circulate, noting several strategies to high in a math forum.

Introduce students to a math forum routine:
Explain that a math forum is a routine where students share and listen to classmates' strategies and models. Set expectations and active listening protocols for this important routine. Based on students' work in the previous lesson, ask several students to share their strategies with the class, modeling on the open number line. Be sure to highlight the different strategies students used such as place-value splitting, jumping by whole tens, getting to a friendly number, counting on, and the use of the commutative and associative properties of addition.

Administer adding length work sample assessment:

Adding Lengths Work Sample

Show your thinking for problems 1a, 2a, and 3a with words, numbers, models, or equations. Label your answers with the correct units.

1a Mark's pillow is 53 centimeters long and his book is 26 centimeters long. If Mark lays the pillow and the book end-to-end, what is their total length in centimeters?

b Which equation best represents problem 1a? (The letter *c* stands for centimeters.)

○ $53 - 26 = c$ ○ $53 + c = 26$

○ $26 + c = 53$ ○ $26 + 53 = c$

2a Laurie has 2 strips of paper. The first strip is 38 centimeters long. The second strip is 25 centimeters long. If Laurie lays the two strips of paper end to end, what is their total length?

b Which equation does NOT represent problem 2a? (The letter *l* stands for length.)

○ $38 + 25 = l$ ○ $l + 38 = 25$

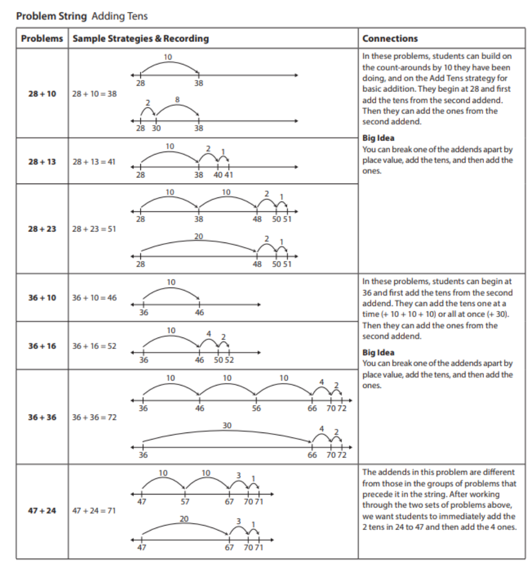
○ $l = 38 + 25$ ○ $25 + 38 = l$

3a Brandon has 2 pieces of string. The first piece of string is 15 centimeters long. The second piece is 99 centimeters long. If Brandon lays the pieces of string end to end, what is their total length?

b Write an equation to represent problem 3a.

Introduce students to a problem string routine:
Introduce each problem one at a time. Encourage students to complete the problems in their heads and to explain their strategies. Model each problem as shown in the chart. Use these problems to encourage students to add tens, as they have done in the class count-arounds.

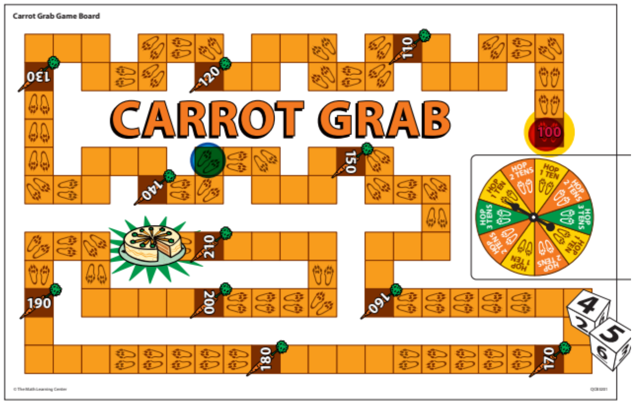
Practice the addition strategy of getting to a friendly number by playing *Carrot Grab:*
Students roll two dice for the ones and spin the game board spinner for tens. Students can break up their number in any way to land on as many multiples of ten as possible where they collect carrots as they move forward on the game board. For example, if a student is on 138 and rolls a 4 and a 3 and spins 2 hops of ten, he/she can move 2 to get to 140, then hop 2 tens and then move the remaining 5, collecting 3 carrots and landing on 145. The player who reaches 210 or beyond and has the most carrots wins. Play a round or two teachers vs. class discussing the different strategies students can use to collect the



Problem String Adding Tens

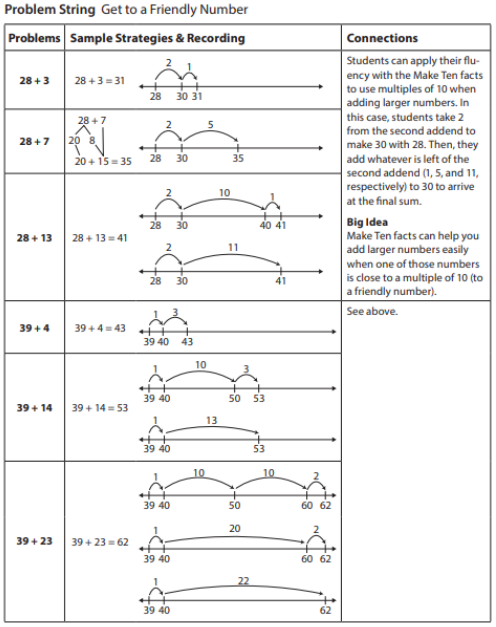
Problems	Sample Strategies & Recording	Connections
28 + 10	28 + 10 = 38	In these problems, students can build on the count-arounds by 10 they have been doing, and on the Add Tens strategy for basic addition. They begin at 28 and first add the tens from the second addend. Then they can add the ones from the second addend. **Big Idea** You can break one of the addends apart by place value, add the tens, and then add the ones.
28 + 13	28 + 13 = 41	
28 + 23	28 + 23 = 51	
36 + 10	36 + 10 = 46	In these problems, students can begin at 36 and first add the tens from the second addend. They can add the tens one at a time (+ 10 + 10 + 10) or all at once (+ 30). Then they can add the ones from the second addend. **Big Idea** You can break one of the addends apart by place value, add the tens, and then add the ones.
36 + 16	36 + 16 = 52	
36 + 36	36 + 36 = 72	
47 + 24	47 + 24 = 71	The addends in this problem are different from those in the groups of problems that precede it in the string. After working through the two sets of problems above, we want students to immediately add the 2 tens in 24 to 47 and then add the 4 ones.

most carrots.



Conduct a problem string to emphasize getting to a friendly number:

Practice the addition strategy of getting to a friendly number by playing *Carrot Grab:*
Students play Carrot Grab in partners, a work place they will return to throughout the year as necessary.

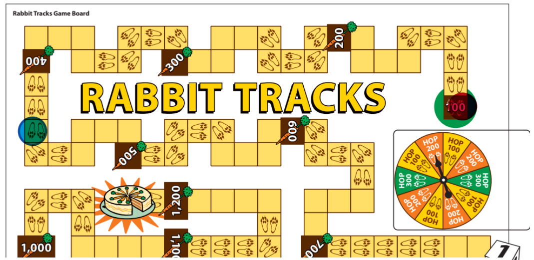


Problem String Get to a Friendly Number

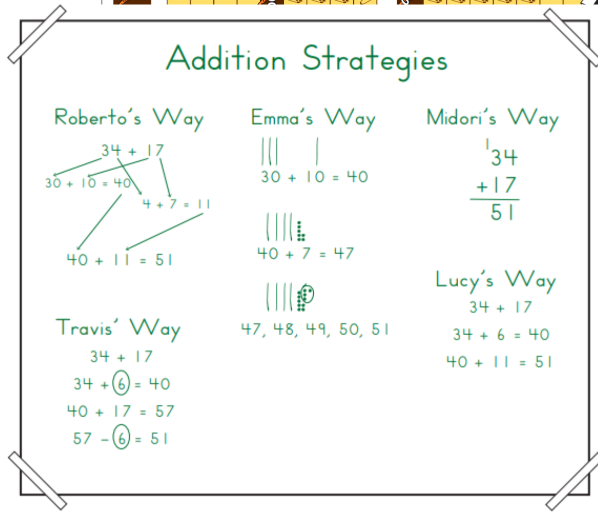
Problems	Sample Strategies & Recording	Connections
28 + 3	28 + 3 = 31	Students can apply their fluency with the Make Ten facts to use multiples of 10 when adding larger numbers. In this case, students take 2 from the second addend to make 30 with 28. Then, they add whatever is left of the second addend (1, 5, and 11, respectively) to 30 to arrive at the final sum. **Big Idea** Make Ten facts can help you add larger numbers easily when one of those numbers is close to a multiple of 10 (to a friendly number).
28 + 7	28 + 7 20 8 20 + 15 = 35	
28 + 13	28 + 13 = 41	
39 + 4	39 + 4 = 43	See above.
39 + 14	39 + 14 = 53	
39 + 23	39 + 23 = 62	

Week 4 students solve story problems that involve adding and subtracting 2-digit numbers. They spend time discussing their strategies and modeling them with the open number line, splitting diagrams, and equations. The final lesson features multi-step problems involving both addition and subtraction, and the teacher helps students not only model their strategies with equations but also write equations to represent the problem situation.

Practice the addition strategy of getting to a friendly number by playing *Rabbit Tracks:*
Play teacher vs. class as you introduce students to *Rabbit Tracks*, a game like *Carrot Grab* but with greater numbers. In this game the dice represent tens and the spinner hundreds. Players add their tents and hundreds to determine how far they will advance on the game board. Students can break apart their numbers in any way to land on as many multiples of 100 as possible, where they will collect carrots. Players win when they reach 1200 or beyond first and have the most carrots. If a player is on 240 and rolls 4 and 5 and spins 1, they will have 4 tens + 5 tens + 100. They can jump 60 to get to 300, then hop 100 to grab other carrots and then hop the remaining 30.
Partner students up to play against one another. Students will revisit this work place throughout the year as necessary.



Model and discuss two-digit addition story problems:
Present this story problem to the class. *"Malcolm collects special marbles. He had 34 marbles. For his birthday, Malcolm received 17 more special marbles. How many marbles does Malcom have now?"* As a class, write an equation to solve this problem. Have students write $34 + 17 = m$ in their math journals. Ask students to use any strategy they want to solve the problem. After students work, have students share their strategies. Make a class chart highlighting the different addition strategies students share.

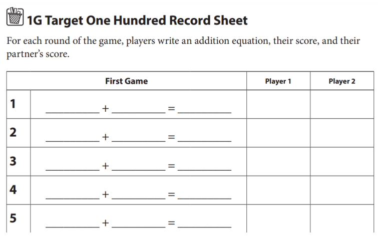


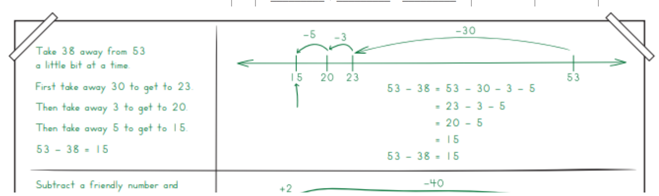
Give students another word problem and have them work independently thinking about the various strategies they discussed in the first problem. Encourage students to estimate what the answer will be before doing the math to determine if their answers are reasonable. Ask students to model 2 different strategies for solving the problem.

Practice various addition strategies by playing *Target 100*:
Players select 6 number cards (0-9) and create two 2-digit numbers whose sum is as close to 100, over or under, as possible. Players play 5 rounds. A student's

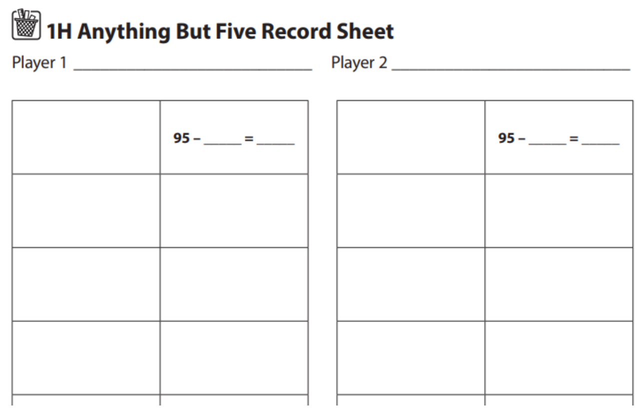
score each round is the difference between their sum and 100. Play several rounds of teacher vs. class discussing addition strategies and different options for using the number cards to get as close to 100 as possible. Students use the recording sheet to keep track of their equations and points scored each round.

Model and discuss two-digit subtraction story problems:
Present this story problem to the class. *"Max has 38 toy cars. Sam has 53 toy cars. How many more does Sam have than Max?"* As a class, write an equation to solve this problem.
Have students write *53 - 38 = c* in their math journals. Ask students to use any strategy they want to solve the problem. After students work, have students share their strategies. Make a class chart highlighting the different subtraction/addition strategies students share. Be sure to discuss how some students used subtraction, but others used addition.
Repeat these steps with another word problem.





Model and solve multi-step subtraction problems:
Read and discuss several multi-step word problems. Write equations as a class and ask students to solve them in their math journals. Encourage students to use class anchor charts from previous lessons highlighting different addition and subtraction strategies.



Practice subtraction strategies by playing *Anything but Five*:
Play teacher vs. class as you explain the rules of the game. Students race from 95 back to 0 by rolling a 4-9 die as many as 3 times each turn. The player subtracts the total amount rolled on each turn, practicing different subtraction strategies. If a player rolls a 5, they lose a turn. As you play with students, model how students can use break apart place value models and open number lines to solve their subtraction problems.

Administer Unit 1 Post Assessment

Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)
- Use of the tape measure and ruler creates a real-world connection between the open number line and the length model.
- Students use rulers, tape measures and story problems to bring a real-world context to addition and subtraction problems.
- The use of the math forum routine gives students the chance to practice making viable arguments to support their thinking and to make sense of and critique the thinking of others.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☐ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☒ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play.
- See "Game Variations" in work place guides.

- See “Assessment and Differentiation” in work place teacher masters.

Support:

- When applicable give students smaller numbers to practice the strategies.
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall.
- See “Game Variations” in work place guides.
- See “Assessment and Differentiation” in work place teacher masters.

MLL (Multilingual Learners)**:**

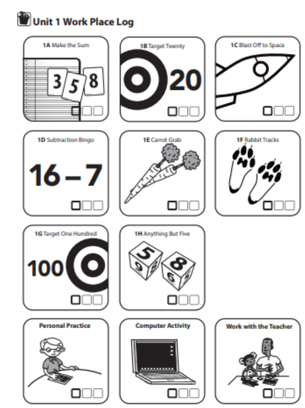
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Pre-Assessment
- Adding Lengths Work Sample
- Work Places
- Home Connections
- Student Book Class Work
- Problem Strings



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Addition and Subtraction Checkpoint

Addition & Subtraction Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name														
1a–b Solves an addition story problem within 100, shows work. *17 tickets. Work will vary. Example: You can use Doubles Plus One to solve the problem, because 8 + 8 = 16 and 1 more is 17.*	2.OA.1 2.OA.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to the correct answer															
1c Writes an equation to represent the problem. *8 + 9 = 17 or 9 + 8 = 17*	2.OA.1	**1 pt.**															
2a–b Solves a a subtraction story problem within 100, shows work. *$11. Work will vary. Example: 20 – 10 = 10, but you're only taking 9 away, so the answer is 11.*	2.OA.1 2.OA.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to the correct answer															
2c Writes an equation to represent the problem. *20 – 9 = 11*	2.OA.1	**1 pt.**															
3a–b Solves a two-step story problem involving addition and subtraction, shows work. *$23, $3. Work will vary. Example: 6 + 8 = 14, and 14 + 9 = 23. $23 is $3 more than $20.*	3.OA.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to the correct answer															
3c Writes equations to represent the problem. *Equations will vary. Example: 6 + 8 + 9 = 23 and 23 – 20 = 3.*	2.OA.1	**1 pt.**															
4 Identifies and explains addition pattern. *Yes. Explanations will vary. Example: 5 + 9 = 14, and 14 is an even number, so she's right.*	3.OA.9	**2 pts.** • 1 pt. for agreeing with the statement • 1 pt. for a reasonable explanation															
5 Writes two different addition equations for 15. *Answers will vary. Examples: 7 + 8 = 15, 10 + 5 = 15.*	2.OA.2	**2 pts.**															
6 Writes two different subtraction equations that equal 9. *Answers will vary. Examples: 12 – 3 = 9, 19 – 10 = 9.*	2.OA.2	**2 pts.**															
7 Solves for the unknown in an addition and a subtraction equation. *8, 12*	2.OA.2	**2 pts.**															
Total Score/Level of Proficiency*		**17 pts.**															

* **Meeting Standard** 13–17 points (75%–100% correct) **Approaching Standard** 9–12 points (50–74% correct) **Strategic** 5–8 points (25–49% correct) **Intensive** 4 points or less (24% or less correct)

- Unit 1 Post-Assessment

Unit 1 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name														
1 Chooses correct equation to model the situation. *$p + 9 = 18$*	2.OA.1	**1 pt.**															
2a–c Writes three different addition equations for 15. *Answers will vary. Example: $10 + 5 = 15$, $8 + 7 = 15$, and $9 + 6 = 15$.*	2.OA.2	**3 pts.** • 1 pt. for each correct equation															
3a–c Writes three different subtraction equations with answer 6. *Answers will vary. Example: $9 - 3 = 6$, $16 - 10 = 6$, and $26 - 20 = 6$.*	2.OA.2	**3 pts.** • 1 pt. for each correct equation															
4 Solves addition combinations to 20. *12, 9, 6, 17, 6, 20*	2.OA.2	**6 pts.** • 1 pt. for each correct answer															
5 Solves subtraction facts to 20. *8, 8, 4, 9, 9, 4, 7, 7*	2.OA.2	**8 pts.** • 1 pt. for each correct answer															
6a Solves an addition story problem within 100 involving 4 addends. *The ant walked 99 mm. Work will vary.*	2.OA.1 2.NBT.6	**2 pts.** • 1 pt. for work (see note) • 1 pt. for correct answer															
6b Solves a subtraction story problem. *He added 25 cm to his line. Work will vary.*	2.NBT.5	**2 pts.** • 1 pt. for work (see note) • 1 pt. for correct answer															
6c Solves a subtraction/comparison story problem. *The first side was 28 cm longer than the second side. Work will vary.*	2.NBT.5	**2 pts.** • 1 pt. for work (see note) • 1 pt. for correct answer															
6d Solves a one-step story problem involving 3-digit subtraction. *122 were science books. Work will vary.*	3.NBT.2	**2 pts.** • 1 pt. for work (see note) • 1 pt. for correct answer															
7a Writes an equation to represent a visual model for addition within 20. *Equations will vary. Possibilities include $6 + 7 = 13$, $10 + 3 = 13$, and $20 - 7 = 13$.*	2.OA.2	**1 pt.** for any correct equation															
7b Explains how to use $7 + 7$ to find $6 + 7$. *Answers will vary. Example: Since $7 + 7$ is 14 and 7 is 1 more than 6, $6 + 7$ is 13, 1 less than 14.*	2.OA.2	**1 pt.**															
		Subtotal page 1															

Unit 1 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name														
8 Writes and solves an equation to match a story problem involving comparison. *Equations will vary. Possibilities include $16 - 9 = 7$ and $9 + 7 = 16$.*	2.OA.1	**1 pt.**															
9 Gives two examples of half facts other than $16 - 8$. *Answers will vary. Possibilities include $18 - 9$, $20 - 10$, $6 - 3$, $8 - 4$, $10 - 5$, etc.*	2.OA.2	**2 pts.** • 1 pt. per correct fact															
10 Reads and responds to a mathematical statement involving comparison. *Yes, $7 + 7$ is a Doubles fact, so $7 + 8$ is a Doubles Plus One fact.*	2.OA.2	**2 pts.** • 1 pt. for correct answer • 1 pt. for viable explanation															
11 Reads and responds to a mathematical statement involving the doubling of any number. *Yes. Explanations will vary. Example: I agree, because if you double any number on the number rack, there will always be the same amount of beads on top of each other. There will never be an extra bead without a partner, so the sum for any Doubles fact has to be even.*	3.OA.9	**2 pts.** • 1 pt. for correct answer • 1 pt. for viable explanation															
12 Explains how the Make Ten addition strategy can be used to solve $9 + 6$, and gives the answer to the combination. *15. Explanations will vary. Example: You can start with 9 and add 1 to get to 10. Then add the rest, 5, to get 15, so $9 + 6 = 15$.*	2.OA.2	**2 pts.** • 1 pt. for correct answer • 1 pt. for viable explanation															
13 Solves a multi-step problem involving addition and subtraction of 3-digit numbers. *Rosa read 17 more pages than Amy. Students' work will vary. Example: $129 + 124 = 253$ and $127 + 109 = 236$. $253 - 236 = 17$.*	3.NBT.2 3.OA.8	**2 pts.** • 1 pt. for correct answer • 1 pt. for work (see note)															
		Subtotal page 2															
		Subtotal from page 1															
Total Score/Level of Proficiency*		**42 pts.**															

* **Meeting Standard** 32–42 points (75%–100% correct) **Approaching Standard** 21–31 points (50–74% correct) **Strategic** 11–20 points (25–49% correct) **Intensive** 10 points or less (24% or less correct)

Note about problems 6a–6d and 13: Students' work must involve a the use of a strategy more sophisticated than counting all, counting on by 1s, or counting backward by 1s. A student who has used a viable strategy but made a minor arithmetical error should still be awarded 1 point, even though the answer is incorrect. A student who gives the correct answer without showing any work, or a student who gives the correct answer but shows work that doesn't relate to the answer in any kind of sensible way, should be awarded only 1 point.

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 2: Introduction to Multiplication
Pacing	5 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** **1. Make sense of problems and persevere in solving them.** 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique reasoning of others. **4. Model with mathematics.** 5. Use appropriate tools strategically. 6. Attend to precision. **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.** **Priority/Focus Standards:** **3.OA.1** Interpret products of whole numbers. **3.OA.3** Solve multiplication problems with products to 100 involving situations of equal groups and arrays. **3.OA.4** Solve for the unknown in a multiplication equation involving 3 whole numbers.

3.OA.5 Multiply using the commutative property.
3. OA.6 Solve division factors by finding an unknown factor.
3.OA.7 Fluently multiply with products to 100 using strategies.
3. OA.8 Solve two-step story problems using addition, subtraction, and multiplication.
3.OA.9 Identify patterns among basic multiplication facts.
3.MD.3 Take a scaled picture graph and a scaled bar graph to represent a data set with several categories.

Supporting Standards:
3.OA Use and explain additive strategies to demonstrate an understanding of multiplication.
3.OA Solve one-step story problems using multiplication and division.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students do?*	Concepts *What must students know?*
1. Interpret products of whole numbers.	1. Tiling to show the area of a rectangle.
2. Write story problems to match a multiplication expression or equation.	2. Multiplication and division within 100 to solve word problem situations involving equal groups, arrays, and measurement quantities.
3. Use additive strategies to demonstrate understanding of multiplication.	3. You can solve multiplication problems with a repeated addition equation.
4. Solve for the unknown number in a multiplication or division equation relating three whole numbers.	4. Multiplication and division are inverse operations.
5. Multiply using the commutative property.	5. Numbers multiplied in different orders will result in the same product.

6. Solve a division problem using a related multiplication problem.	6. Multiplication and division are inverse operations.
7. Fluently multiply within 100 using strategies.	7. There are different strategies (double, double-double, half tens, etc.) that can be employed to solve basic fact equations within 100.
8. Solve 2-step story problems using addition, subtraction, and multiplication.	8. Sometimes a story problem requires multiple steps and operations.
9. Identify and explain patterns in the multiplication table.	9. Predictable and repeating patterns emerge from the multiplication table: these can be uncovered by shading different multiples of numbers in different colors.
10. Represent data in scaled pictographs and bar graphs to solve one-step comparison problems in context.	10. Data can be visually represented and easily interpreted in different types of graphs.

Essential Questions *What essential questions will be considered?*	Corresponding Big Ideas *What understandings are desired?*
1. How can we represent multiplication and division situations mathematically? 2. Why is it important to understand arithmetic patterns? 3. How do we model with mathematics?	1. Quantities and operations can be represented numerically, visually, and concretely in various ways. Problem solving depends upon choosing wise ways to represent the operation. 2. The understanding of patterns allows for flexible and fluent thinking and the formation of rules about numbers, quantities, and relationships. 3. Many skills are used to model with mathematics to represent problem situations such as deciding what information is important, locating information to solve a problem, interpreting and creating graphs, creating

	equations, making charts, etc. It is also important to evaluate results in the context of the situation and reflect on whether the results make sense.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.c:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
Books / Media: ● *Two of Everything* by Lily Toy Hong ● *Too Many Kangaroo Things to Do!* by Stuart J. Murphy ● *Spunky Monkeys on Parade* by Stuart J. Murphy ● *Each Orange Had 8 Slices* by Paul Giganti Jr. ● *Double the Ducks* by Stuart J. Murphy ● *Bunches and Bunches of Bunnie*s by Louise Matthews ● *Amanda Bean's Amazing Dream* by Cindy Neuschwander ● *The Best of Times* by Greg Tang ● Multiplication and Division Books ● Young Mathematicians at Work: Constructing Multiplication and Division **Online Resources / Websites:** ● https://www.mathlearningcenter.org/apps ● MLC Number line App ● Game: Bunny Times ● Game: Fractis ● Game: Meteor Multiplication ● Game: Multiplication Grand Prix ● MLC Number Frames App

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Array: an arrangement consisting of equal rows and equal columns.
Bar Graph: a graph that uses horizontal or vertical bars to show frequency of data.
Commutative Property of Multiplication: the property by which the product remains unchanged no matter how the numbers being multiplied are ordered, so that *a x b = b x a*.
Equation: a mathematical statement asserting that two quantities have the same value.
Factor: a whole number that divides easily into another number.
Multiple: a number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3.
Picture Graph: a graph that uses pictures or symbols to show frequency of data.
Product: the result of multiplying 2 or more numbers; in the array model, the product is the area of the array.
Ratio Table: a model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
Table: a collection of data that has been organized into columns and rows.
Variable: a quantity that can change or have different values; also, a symbol (often a letter) that stands for a variable.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

This unit introduces multiplication by immersing students in a wide variety of multiplicative situations. When solving problems that are embedded in different contexts and that invite them to think of the operation in different ways, students make use of a variety of models for multiplication, including equal groups, arrays, the number line, and ratio tables. They also apply the associative and distributive properties to develop efficient, reliable, and generalizable strategies for multiplying. They track these strategies on a multiplication table featuring products from 0 to 100 and apply what they have learned by solving problems that involve scaled graphs and story problems with multiple steps and operations.

Learning Tasks Per Week (Including Instructional Strategies)

Week One: Multiplication in Context Students examine arrays that facilitate repeated addition and skip-counting and encourage multiplicative strategies such as doubling, and use stamps to efficiently determine the value of whole sets. They explore a coral reef scene that invites them to develop strategies beyond repeated addition, including doubling, proportional relationships, and partial products. Students also take a unit pre-assessment and learn a new Work Place.

Lesson One: The Pet Store
This session lays the foundation for a deeper understanding of multiplication. Students delve into multiplicative reasoning and properties of multiplication with an investigation of a pet store that's full of arrays of items. Students work in pairs to find out how many of each item are available in the store and how much they cost. Toward the end of the session, students share their work.

Lesson Two: Unit 2 Pre-Assessment
The session begins with a problem string. Groups of stamps provide the jumping off point for the next steps in exploring and understanding multiplication. Students look at groups of stamps and find the total cost of each group. They discuss and share their strategies together. Students also take the Unit 2 Pre-Assessment.

Lesson Three: Stamps and Assessment Reflections
In today's investigation, students continue exploring arrays of stamps. The class reflects on the problem string from the previous session and solves one new problem together. They use and expand those strategies as they work in pairs to find the total cost each for several more sets of stamps. Then, students reflect on their Unit 2 Pre-Assessment.

Lesson Four: Stamps
Students convene for a math forum to share their work and discoveries from Session 3. Then they participate in a problem string focused on doubling.

Lesson Five: Seascape Problems/Work Place 2A Loops and Groups
Students quickly learn a new Work Place game called Loops & Groups, which they will play in Session 6. Then they begin a two-day exploration of a coral reef ecosystem, which provides a new context for investigating multiplication. Using a small clownfish as a basic unit of measure, students figure out how much longer and taller other reef species are when compared with the clownfish. Work Place 2A Loops & Groups Players roll a die two times. The first roll determines how many loops to draw, and the second roll determines how many shapes to draw in each loop. The player writes a multiplication equation ($4 \times 3 = 12$) or a sentence (4 groups of 3 equals 12). After 5 rounds, players add up their products, and the player with the higher sum wins.

Week Two: Multiplying with Number Lines & Arrays Students make cube trains and paper strips to show the multiples of 2–10. These iterating units help them understand multiplication as comparison: something times something else. Students solve number line puzzles, and they investigate arrays as they help a window washer count windowpanes. In Sessions 3 and 4, students explore doubling, using partial products, and making use of 5s and 10s facts. In the final session, they move from the discrete array structure of the paned windows to a contiguous array of mailboxes.

Lesson Six: Seascape Forum
In this session, students participate in a math forum in which they share discoveries and strategies from their work in Session 5. The discussion supports them to extend use of more formal language and notation for multiplication.

Lesson Seven: Count-Arounds
This session begins with a count-around in which students count by 3s, 6s, and then 9s to 90, making predictions and observations as they go. Then, students complete a checkpoint to gauge their understanding of some of the skills and concepts presented in the unit thus far. Students spend the rest of the session visiting Work Places.

Lesson Eight: Cube Trains and Multiples Strips
This session begins with several count-arounds. The class discusses multiplication, and students work in pairs to build measuring strip made of cubes as well as matching paper strips for multiples from 2 through 10. Then two or three pairs look at their number lines together to discover relationships between multiples. The class reconvenes and looks at all the number lines to find more number line relationships.

Lesson Nine: Watertown's Window Washer/Work Place 2B Frog Jump Multiplication
This session is the first of a three-day investigation in Watertown. Today, students meet Wally and help him figure out how many windows he must wash by looking at a visual problem string of arrays of windows. The teacher introduces Work Place 2B Frog Jump Multiplication, which involves multiplication on the number line.
Work Place 2B Frog Jump Multiplication Players take turns rolling a die numbered 1–6 two times. The first roll tells how many jumps to take along the number line; the second roll tells how long each jump will be. Players mark their jumps on the number line and write a multiplication equation to show the results. Each player takes 4 turns and then adds their products to find the total sum. The player with the higher sum wins.

Lesson Ten: Wally Keeps Washing
Students continue to help Wally figure out numbers of windows in Watertown. Today's windows are designed to nudge students toward using what they know about the facts for 5 and 10 to solve problems efficiently. The session begins with a visual problem string of sets of windows. Students work with partners to figure out more number line puzzles and then share their thinking.

Week 3: Ratio Tables & the Multiplication Table Module 3 builds on students' existing skills and focuses on new ways of seeing multiplication. Students solve story problems and generate a list of strategies they have learned so far. They begin to explore the ratio table, a model and tool that invites proportional thinking. In Sessions 3 and 4, they identify and label types of multiplication facts in a table to help them begin to internalize these basic combinations. **Lesson Eleven: The Watertown Post Office/ Work Place 2C Cover Up** In the final Watertown session, students work with arrays of windows as a model of multiplication. Students begin by looking at small arrays of mailboxes and then at an entire wall of mailboxes. Then the teacher introduces Work Place 2C, which gives students more practice representing multiplication within 100 using arrays. Work Place 2C Cover Up Players take turns spinning two numbers, drawing an array with those dimensions on a 10-by-10 grid, and finding the product represented by the array (total area of the array). Each player takes four turns and then finds the total of their four products. The player whose total is closest to 100 wins. **Lesson Twelve: Doubling String and Pet Store Story Problems** The session starts with a problem string on the doubling strategy. Students complete a work sample on a series of story problems to apply contexts and strategies of Modules 1 and 2 to novel situations. The class discusses strategies for solving multiplication and division situations, and the teacher generates a list of their strategies. **Lesson Thirteen: Price Lists** The teacher leads the class in a Cats & Legs Problem String. Then students work with partners to fill in a ratio table of prices for rabbit food at the pet store. The session ends with a discussion of strategies (doubling, times 10) and observations about the price list ratio table. **Lesson Fourteen: Multiplication Strategies, Part 1 of 2** This is the first of two sessions in which students explore strategies for specific multiplication facts and then locate collections of related facts on the multiplication table. Today, students use arrays to illustrate how doubling can help them multiply by 3, 4, and 8. In the following session, they will explore how knowing their times-10 facts can help them multiply by 5, 6, and 9. **Lesson Fifteen: Multiplication Strategies, Part 2 of 2** The session begins with a problem string that helps students explore how knowing the times-10 facts can help them multiply by 5, 6, and 9. Then they take some time to complete the Multiplication Table, study it, and discuss the patterns they see among the basic multiplication facts.
Week Four: Story Problems with Graphs & Multiple Operations Students solve multi-step problems in the context of library

books. The problems require use of a variety of operations—including multiplication and multi-digit addition and subtraction—to answer questions about data. Students complete the Unit 2 Post-Assessment.

Lesson Sixteen: Ice Cream Survey/ Workplace 2D Doubles Help
The teacher surveys the class to find students' ice cream flavor preferences. Students work in pairs to represent the data on a picture graph. Each student then transfers the information to a bar graph. Students compare the two types of graphs and observe the advantages of each. The teacher introduces Work Place 2D Doubles Help, and then the Grocery Shopping Home Connection. Work Place 2D Doubles Help Players spin two spinners to generate a problem involving multiplying by 3 or 4. The player solves the problem and records an equation in the column for the Doubles fact that can be used the solve the problem. The first player to write an equation in each column wins the game.

Lesson Seventeen: Book Lovers Survey
The teacher surveys the class to find out which of four types of books each student likes best. The data is organized, and students work in pairs to represent the survey results on a picture graph. Students then transfer the data to a bar graph, compare the two types of graphs, and go to Work Places.

Lesson Eighteen: Library Books Data
Students organize data about library books and then display the data using a bar graph. Then they solve several multi-step problems about the data, which gives them a chance to apply the computational skills they have been developing. As they finish the assignment, students go to Work Places. the teacher concludes the session by helping students write equations to represent two of the problems they solved.

Lesson Nineteen: Library Books Problems
Students solve multi-step problems involving all four operations in the context of the school library. The problems invite them to consider multiplication in several ways while also employing strategies for multi-digit addition and subtraction. As they finish the assignment, students go to Work Places. The teacher concludes the session by helping students write equations to represent two of the problems.

Lesson Twenty: Unit 2 Post-Assessment
Students take the Unit 2 Post-Assessment and then go to Work Places.

Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to “Literature Connections” in Resources.)
- The use of the window washing context encourages students to look for these patterns in buildings in the real world. It also creates a real context for exploring arrays as they naturally occur in our architecture and natural world.
- The ice cream survey provides students with the experience of data collection, representation and analysis that occurs in more complex ways in the real world.

Westbrook Public Schools’ Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play.
- See “Game Variations” in work place guides.
- See “Assessment and Differentiation” in work place teacher masters.

Support:
- Ensure instructional materials are systematic and explicit. They should include numerous clear models of easy and difficult problems, with accompanying teachers think-alouds.
- Provide students with opportunities to solve problems in a group and communicate problem-solving strategies.

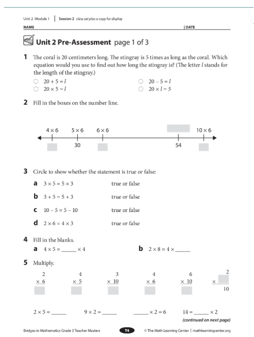
● Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type. (Multiplication and Division Problem Types are linked in Math Teaching Practice Resources). ● Difficulty identifying information in a problem situation can be improved by providing more experiences making explicit connections between their representations (models, or pictures). ● Students should work with visual representations of mathematical ideas. ● If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulations first. ● Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution. ● Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review. ● Work Places Sentence Frames - Bridges Grade 3 Resource. ● At times, partner struggling students with students who are very articulate about their mathematical thinking so they can hear (through conversations) how these students have made sense of the problems
MLL (Multilingual Learners)**:** ● Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language. ● Pre-teach vocabulary in ways that connect to students' prior knowledge. ● Display posters of graphic representations of vocabulary words. ● Provide support to assist in explaining thinking with sentence starters and work banks. ● Use Work Place Sentence Frames or other sentence frames to assist students in math discourse. ● Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help. ● English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 2 Pre-Assessment
- Pet Store Story Problems Work Sample
- Work Places
- Home Connections
- Student Book Class Work



Unit 2 Module 1 | **Session 2** *class set plus a copy for display*

NAME | DATE

Unit 2 Pre-Assessment page 1 of 3

1 The coral is 20 centimeters long. The stingray is 5 times as long as the coral. Which equation would you use to find out how long the stingray is? (The letter l stands for the length of the stingray.)

- ○ $20 + 5 = l$
- ○ $20 - 5 = l$
- ○ $20 \times 5 = l$
- ○ $20 \times l = 5$

2 Fill in the boxes on the number line.

3 Circle to show whether the statement is true or false:

a $3 \times 5 = 5 \times 3$ true or false

b $3 + 5 = 5 + 3$ true or false

c $10 - 5 = 5 - 10$ true or false

d $2 \times 6 = 4 \times 3$ true or false

4 Fill in the blanks.

a $4 \times 5 =$ _____ $\times 4$ **b** $2 \times 8 = 4 \times$ _____

5 Multiply.

2×6 4×5 3×10 4×6 6×10 $2 \times \square = 10$

$2 \times 5 =$ _____ $9 \times 2 =$ _____   _____ $\times 2 = 6$ $14 =$ _____ $\times 2$

(continued on next page)

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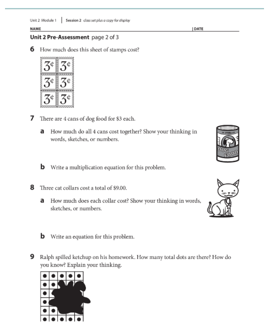


Unit 2 Module 1 | **Session 2** *class set plus a copy for display*

NAME | DATE

Unit 2 Pre-Assessment page 2 of 3

6 How much does this sheet of stamps cost?

7 There are 4 cans of dog food for $3 each.

a How much do all 4 cans cost together? Show your thinking in words, sketches, or numbers.

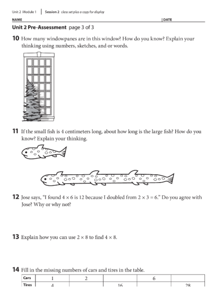
b Write a multiplication equation for this problem.

8 Three cat collars cost a total of $9.00.

a How much does each collar cost? Show your thinking in words, sketches, or numbers.

b Write an equation for this problem.

9 Ralph spilled ketchup on his homework. How many total dots are there? How do you know? Explain your thinking.



Unit 2 Module 1 | **Session 2** *class set plus a copy for display*

NAME | DATE

Unit 2 Pre-Assessment page 3 of 3

10 How many windowpanes are in this window? How do you know? Explain your thinking using numbers, sketches, and or words.

11 If the small fish is 4 centimeters long, about how long is the large fish? How do you know? Explain your thinking.

12 Jose says, "I found 4×6 is 12 because I doubled from $2 \times 3 = 6$." Do you agree with Jose? Why or why not?

13 Explain how you can use 2×8 to find 4×8.

14 Fill in the missing numbers of cars and tires in the table.

Cars	1	2		6	
Tires	4		16		28

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

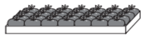
- Unit 2 Multiplication Checkpoint
- Unit 2 Post-Assessment

NAME | DATE

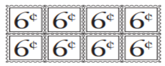
Multiplication Checkpoint

Pablo lives in New York City. He likes to walk around the city and look at all the people, places, and things. Solve the following problems about Pablo's adventures. Label each answer with the correct units. Use numbers, sketches, or words to show your thinking.

1 Pablo walked past a fruit market with boxes of apples, oranges, lemons, and more. How many apples are on display at the fruit market?



2 Pablo went into the Post Office to buy these 8 stamps. How much did Pablo pay for his stamps?



3 Pablo watched people getting on and off the subway at the Times Square station. He saw 8 people wearing coats. Each coat had 5 buttons on it. How many buttons did Pablo see?

4 Pablo walked up to Central Park. He saw a trash can that was 3 feet tall. Then, he saw a lamppost that was 4 times as tall as the trash can. How tall was the lamppost?

Unit 2 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Chooses correct equation to represent the situation. *4 × 20 = h*	3.OA.1	**1 pt.**	
2 Uses entries on a number line to help solve multiplication facts. *24, 40, 9, 80*	3.OA.7 3.OA.9	**4 pts.**	
3a–d Identifies whether the equation is true or false. *a. False, b. True, c. True, d. False*	3.OA.5 3.OA.7	**4 pts.**	
4 Solves for the unknown in multiplication equations. *4, 9*	3.OA.4 3.OA.5 3.OA.7	**2 pts.**	
5 Finds factors or products of multiplication combinations. *21, 30, 50, 40, 24, 5, 24, 36, 6, 8*	3.OA.4 3.OA.7	**10 pts.**	
6 Finds the price of the sheet of stamps, 8 stamps at 3 cents each. *$0.24 or 24 cents*	3.OA.1 3.OA.3	**1 pt.**	
7a–b Solves a one-step multiplication story problem and writes a multiplication equation to represent the problem. *a. $20 or 20 dollars. Work will vary. b. 5 × 4 = 20 or 4 × 5 = 20*	3.OA.1 3.OA.3	**3 pts.** - 1 pt. for work (see note) - 1 pt. for correct answer - 1 pt. for viable equation	
8a–b Solves a one-step division story problem and writes a division equation to represent the problem. *a. $5.00 or 5 dollars. Work will vary. b. 15 ÷ 3 = 5 or 15 ÷ 5 = 3*	3.OA.3	**3 pts.** - 1 pt. for work (see note) - 1 pt. for correct answer - 1 pt. for viable equation	
Subtotal page 1			

Note about problems 7 & 8: Students' work must involve a strategy that could lead to the correct answer.

- For problem 7, the strategy should be more sophisticated than counting 5 groups of 4 marks one by one, starting from 1. Acceptable strategies include skip counting, repeated addition, and adding 2 or 3 sets of 4 and counting on from there.
- For problem 8, using 1 by 1 counting to model and solve the situation is not optimal, but is still acceptable. For example, a student might draw a circle to represent each bag of cat food, and share out 15 marks equally among the 3 circles. Other acceptable strategies include using a related addition or multiplication fact, and repeated subtraction.
- A student who has used a viable strategy but made a minor arithmetical error should still be awarded 1 point, even though the answer is incorrect. A student who gives the correct answer without showing any work, or a student who gives the correct answer, but shows work that doesn't relate to the answer in any kind of sensible way, should be awarded only 1 point.

Unit 2 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
9 Finds the number of elements in a rectangular array in which some of the elements are hidden. *24 stars. Explanations will vary.*	3.OA.3	**2 pts.** - 1 pt. for explanation - 1 pt. for correct answer	
10 Finds the number of elements in a rectangular array. *28 panes. Explanations will vary.*	3.OA.3	**2 pts.** - 1 pt. for explanation - 1 pt. for correct answer	
11 Uses estimation to find the length of a larger fish based on the length of a smaller fish. *About 12 inches (or 1 foot) long. Explanations will vary.*	3.OA.3	**2 pts.** - 1 pt. for an answer that is within 2 inches of 12 - 1 pt. for explanation	
12 Responds to the assertion that 4 × 6 = 24 because 4 × 6 is double 2 × 6 = 12. *Yes. Explanations will vary. Examples: "4 × 6 = 24, so he must be right," or, "2 × 6 = 12, and 4 × 6 is like doubling 2 × 6, so it makes sense that the answer to 4 × 6 is twice as much as 12."*	3.OA.7 3.OA.9	**2 pts.** - 1 pt. for correct answer (yes) - 1 pt. for an explanation that makes sense	
13 Explains how to use 2 × 7 to find 4 × 7. *Explanations will vary. Example: If you find 2 × 7, you know that 4 × 7 is twice as much because you have doubled the number of 7s you are looking for.*	3.OA.7 3.OA.9	**1 pt.**	
14 Fills in a ratio table based on multiplication and division relationships. *2, 16, 6, 36*	3.OA.1 3.OA.7	**4 pts.**	
Subtotal page 2			
Subtotal from page 1			
Total Score/Level of Proficiency*		**41 pts**	

* **Meeting Standard** 31–41 points (75%–100% correct) **Approaching Standard** 21–30 points (50–74% correct) **Strategic** 11–20 points (25–49% correct) **Intensive** 10 points or fewer (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Math
Unit of Study	Unit 3: Multi-Digit Addition and Subtraction
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

3.MP.1. Make sense of problems and persevere in solving them.
3.MP.2. Reason abstractly and quantitatively.
3.MP.3. Construct viable arguments and critique reasoning of others.
3.MP.4. Model with mathematics.
3.MP.5. Use appropriate tools strategically.
3.MP.6. Attend to precision.
3.MP.7. Look for and make use of structure.
3.MP.8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
3.OA.8 Solve two-step story problems using addition, subtraction, multiplication, and division.
3.OA.8 Write equations with a letter standing for the unknown quantity to represent two-step story problems.
3.OA.8 Assess the reasonableness of answers to story problems using mental computation.

3.NBT.1 Round whole numbers to the nearest ten or the nearest hundred.
3.NBT.2 Use strategies and algorithms based on place value, properties of operations, or the relationship between addition and subtraction to add and subtract fluently with sums and minuends to 1000.

Supporting Standards:
3.OA Solve one-step story problems using addition and subtraction.
3.NBT Estimate sums and differences to approximate solutions to problems.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
• Use place value to round numbers to the nearest 10 or 100.	• All whole numbers come in between two-decade numbers and 2 hundreds; we can use place value and counting sequence to determine which decade or hundred the number is closer to.
• Fluently add and subtract within 1000 using strategies and algorithms.	• Basic addition and subtraction facts to 20. Strategies to extend the basic facts to larger numbers.
• Solve two-step word problems.	• Addition and subtraction problems follow typical structures. Sometimes a problem requires more than one operation to find a solution.
• Represent problems using equations with a letter standing for the unknown quantity.	• An unknown number in an equation can be represented with a letter. We can solve for the unknown in any position within an equation.

• Assess the reasonableness of answers using mental computation and estimation strategies.	• By estimating an answer before using computation, we can determine if our computation makes sense.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What is the difference between rounding and estimating?	1. Estimating means to make an approximation that gives you a close, but not an exact answer. Rounding is a type of estimation. Rounding is changing a number to a less exact number that is more convenient for computation when an exact answer is not required or to check the reasonableness of an answer.
2. What strategies support the efficient solving of problems involving addition and subtraction?	2. Efficient and fluent solving of addition and subtraction problems is supported using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.c:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
Informational Texts: • **Informational Books:**   ○ For Good Measure

Children's Literature:

- *The 329th Friend* by Marjorie Weinman Sharmat
- *Let's Estimate* by David A. Adler
- *Great Estimations* by Bruce Goldstone
- *Millions to Measure* by David A. Schwartz
- *Telling Time* by Jules Older
- *Sir Cumference and the Roundabout Battle* by Cindy Neuschwander

Online Resources / Websites:

- MLC Number Line App
- MLC Number Pieces App
- Zoomable Number line

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Algorithm: a step-by-step procedure for computing that gives the correct results in every case when the steps are carried out correctly.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Expanded Form: a way to write a number that shows the place value of each digit rounding - approximating a number to a specific place value based on the digit immediately to the right of that place; for example, rounding $3.82 to the nearest dollar is $4 or rounding 63 to the nearest ten is 60.
Sum or Total: the result of adding two or more numbers.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Unit 3 reviews and extends students' thinking about place value, multi-digit addition and subtraction, and problem solving. In the first module, students are introduced to the idea of rounding 2- and 3-digit numbers to the nearest ten and the nearest hundred. This skill is extended into the realm of computation, as students use rounding as a way to estimate and check the results of adding and subtracting multi-digit numbers. Along with reviewing and deepening their understandings of strategies learned in second grade, students are introduced to the standard algorithms for adding and subtracting multi-digit numbers toward the end of the unit.
Learning Tasks Per Week (Including Instructional Strategies)
Week 1: **Lesson One: Unit 3 Pre-Assessment** Students take the Unit 3 Pre-Assessment, then choose a Work Place as time allows. The teacher introduces and assigns the Multiplying & Dividing Home Connection. **Lesson Two: Rounding to the Nearest Ten** Today's session opens with rounding 2- and 3-digit numbers to the nearest ten. Students and teachers use measuring tapes, base ten pieces, and sketches of open number lines to help see and understand the concepts involved. The teacher then introduces a new Work Place game, Round Ball Tens, by playing it with the class, and then having students play it again in pairs. Work Place 3A Round Ball Tens Players spin to get two numbers and arrange them to form a 2-digit number. Then, they round that number to the nearest ten and record it on the record sheet in the box below the basketball hoop labeled with that ten. The first player to get at least one number in each basket wins. **Lesson Three: Round and Add Tens** Today's session opens with a problem string that reviews the strategy of using friendly numbers, this time in the context of adding 2- and 3-digit numbers. Then the teacher introduces a new Work Place game that provides practice adding and rounding 2-digit numbers to the nearest 10, first playing it with the whole class. Work Place 3B Round & Add Tens Players work together to spin two different spinners twice, generating two 2-digit numbers. They round each number to the nearest ten. Then they find the sum of actual numbers and of the rounded numbers. They find the difference between the sum of the actual numbers and the sum of the rounded numbers. The difference is their score for the first round of the game. Players add their scores after 5 rounds to get a final score.

Lesson Four: Rounding to the Nearest Hundred After reflecting on the unit pre-assessments from Session 1, students follow the teacher's lead in learning how to round 3-digit numbers to the nearest hundred, using base ten pieces, a closed number line, and the open number line. The teacher then introduces a third new Work Place game, Round Ball Hundreds, first playing the game with the class, and then having the students play again in pairs. Work Place 3C Round Ball Hundreds Players take turns drawing three Number Cards from a deck and arranging them to make a 3-digit number. Then, they round that number to the nearest ten and record it on the record sheet in the box below the basketball hoop labeled with that ten. The first player to get at least one number in each basket wins.
Week 2: **Lesson Five: Three-Digit Addition Story Problems** Students solve several 3-digit story problems, developing new strategies or adjusting some of the strategies they generated in Unit 1. As they finish, they go to Work Places. The teacher introduces a new challenge in which students see a model of how someone solved a problem and then match it with a written description of a strategy. **Lesson Six: Three-Digit Addition Story Problems Forum** Students examine a variety of strategies for solving the first and second story problems they worked on in Session 5. **Lesson Seven: Three-Digit Subtraction Story Problems** The session opens with a checkpoint designed to assess students' understanding of the skills and concepts explored in the unit. Then students work on several 3-digit subtraction story problems, solving one problem in pairs and sharing strategies with the class. After that, they solve two more problems independently in preparation for a math forum next session. **Lesson Eight: Constant Difference** Today's session opens with a math forum, during which selected students share their thinking with the class about the problems they solved in the previous session. Then the teacher introduces constant difference, a new subtraction strategy, and the class tries it out with a few more problems. **Lesson Nine: Which Makes the Most Sense?** This session begins with a problem string designed to deepen students' understanding of the constant difference strategy. Next, students work to select the best estimate for a subtraction problem. After students visit Work Places, the teacher introduces the Adding, Card Collecting & Shopping Home Connection.

Week 3:

Lesson Ten: Charting Subtraction Strategies
A whole class discussion has students brainstorming a list of subtraction strategies they've explored recently, with the teacher recording the strategies on a chart. The class discusses and solves a problem together, focusing on how the numbers or the context of the problem can help them decide which strategy to choose. Working in pairs and then independently, students choose strategies to solve more subtraction problems. Their work on the final problem can be collected as a work sample.

Lesson Eleven: Subtraction Strategies Forum
Today's session opens with a math forum, during which selected students share their thinking with the class about the problems they solved during the previous session. Following the forum, students visit Work Places. During this time, the teacher works with small groups or individuals to provide differentiated instruction.

Lesson Twelve: Round and Add Hundreds
This session begins with a checkpoint designed to assess students' skills with adding and subtracting 3-digit numbers and solving two-step story problems. Then the teacher introduces a new Work Place game that provides practice adding and rounding 3-digit numbers to the nearest 100. Once they have played the game as a whole class and then again in pairs, students spend any remaining time visiting Work Places. Work Place 3D Round & Add Hundreds Players roll a die once and spin spinners to form a 3-digit number. They repeat this to form a second 3-digit number. They round each number to the nearest 100. Then they find the sum of the actual numbers and of the rounded numbers. Lastly, they find the difference between the sum of the actual numbers and the sum of the rounded numbers. The difference is their score for the first round of the game. Players add their scores after 5 rounds to get a final score.

Lesson Thirteen: Sketching and Writing Expanded Notation
Today, students revisit and review place value through the thousands place in preparation for rounding, adding, and subtracting 3- and 4-digit numbers during the next two sessions. The teacher reads the 329th Friend and uses it as a basis for building various collections of base ten pieces and to discuss trading tens for hundreds to create a minimal collection. Students explore efficient ways to sketch base ten collections. They work in pairs to build and record minimal collections for 2-, 3-, and 4-digit numbers, then go to Work Places.

Week 4:

Lesson Fourteen: About How Far?

Students read a table to determine the distances between six U.S. cities. They practice rounding the distances to the nearest ten and hundred. The same table will be used in the next session to complete calculations using the actual distances. As students complete the assignment, they spend the remainder of the session visiting Work Places.

Lesson Fifteen: Solving Travel Miles Problems
Students read a table showing the distances between six U.S. cities and use the data to complete calculations with 3- and 4-digit numbers. The rounding practice in the previous session will help students gauge the reasonableness of their answers. They share computation strategies and then demonstrate proficiency with multi-digit subtraction to solve a story problem independently.

Lesson Sixteen: Exploring the Algorithm for Addition
In today's session, students work in pairs to solve a triple-digit addition story problem. They share their strategies with the entire class while the teacher records each method in the form of a poster. The teacher then introduces the standard algorithm and has the whole class practice using it to solve a variety of 3-digit addition problems.

Lesson Seventeen: Think Before You Add
This session opens with a quick round of I Have, You Need. Then, students solve a variety of addition problems and discuss which strategies work best for each problem. At the end of the session, the teacher introduces and assigns the Which Strategy Is Best? Home Connection.

Week 5:

Lesson Eighteen: Exploring the Algorithm for Subtraction
Students work in pairs to solve a 3-digit subtraction story problem. They share their strategies with the entire class while the teacher records each method in the form of a poster. The teacher then introduces the standard algorithm and has the class practice using it to solve a variety of 3-digit subtraction problems.

Lesson Nineteen: Think Before You Subtract
This session begins with a discussion about strategies students used to solve addition problems in the previous session. Then, students solve a variety of subtraction problems and discuss which strategies work best for each problem. Finally, the teacher introduces the Estimates, Sums & Story Problems Home Connection.

Lesson Twenty: Unit 3 Post-Assessment
Students take the Unit 3 Post-Assessment and then go to Work Places.

Interdisciplinary / Real World / Global Connections

- Reminding students of strategies, they have used in the past invites them to connect the problems they are about to solve to past work and reminds them that they have ways to solve these challenging problems.
- Developing fluency with the constant difference strategy is enormously helpful for multi-digit subtraction. Modeling the strategy on the number line helps students look for and make use of structure to understand why the difference between two numbers remains constant when the same number is added to or subtracted from each.
- When you ask students to think carefully about the subtraction strategies they have discussed, you are inviting them to select and use appropriate tools strategically. We hope to see students thinking about the numbers involved in the problem and considering the appropriateness of each strategy for such numbers before selecting the one they think will work best. As is the case when they are selecting any tool for a given task, they are considering the parameters of the task, their own understanding and skills, and the features and capabilities of each tool. This process improves students' mathematical understanding and builds their autonomy as mathematicians.
- It is important for students to decide when they need to attend to precision and when a mathematical question can be answered without an exact calculation. In this case, an exact answer is necessary, but the inexact estimates students have made can help them confirm whether their calculations make good sense.
- When students justify their choice of strategy to classmates, they must think about the numbers involved in the problem and the way in which each strategy available to them is or is not suited to those numbers. While communicating explicitly with one another about their choices, students are deepening their understanding of the strategies and building their computational fluency

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation
Challenge: ● Explore different operations to reach a given target number. Describe what is noticed in the process and how estimation may help to determine the most effective operation and numbers to reach the target. ● Have students think of target numbers between 100 and 10,000 that align with their capabilities and then develop clues, including rounding and estimation, for others to use to figure out the target number. ● Provide students with a problem involving shopping. Have students make an estimate on how much they will spend by trying out various estimation strategies. Students will find out if the estimate is reasonable and calculate the real cost. They will explain in writing how they arrived at their estimate and which estimation strategy was most efficient and accurate.
Support: ● Ensure instructional materials are systematic and explicit. They should include numerous clear models of easy and difficult problems, with accompanying teacher think-alouds. ● Provide students with opportunities to solve problems in a group and communicate problem-solving strategies. ● Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type. ● Students should work with visual representations of mathematical ideas. If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulatives first. (Include the next line for middle school and older students only) Although this can also be done with students in upper elementary and middle school grades, use of manipulatives with older students should be expeditious because the goal is to move toward understanding of and facility with visual representations and finally to the abstract.

- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.
- Difficulty identifying information in a problem situation can be improved by providing more experiences making explicit connections between their representations (models, or pictures).
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told what to do to reach the solution.
- At times, partner struggling students with students who are very articulate about their mathematical thinking so they can hear (through conversations) how these students have made sense of the problems

MLL (Multilingual Learners)**:**

- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words**.**
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Pre-Assessment
- Books and Books and Books Work Sample
- Work Places
- Home Connections
- Student Book Class Work

Books & Books & Books Work Sample Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Uses rounding to estimate the answer to a story problem that involves finding the difference between 403 and 279. Shows work. *Estimates and work will vary. Example: 403 rounds down to 400; 279 rounds up to 300. 400 – 300 = 100, so they read about 100 more books in April.*	3.OA.8 3.NBT.1 3.NBT.2	**2 pts.** • 1 pt. for an estimate around 100, give or take 25 in either direction • 1 pt. for viable work that could lead to a reasonable estimate	
2 Finds the actual difference between 403 and 279. Shows work. *124 more books; work will vary. Example: 403 – 279 = 424 – 300 if you add 21 to both numbers. 424 – 300 = 124.*	3.NBT.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see note)	
3 Writes an equation to match the problem. *Equations may vary. Acceptable equations include: 403 – 279 = 124; 279 + 124 = 403; 403 – 279 = b; 279 + b = 403*	3.NBT.2	**1 pt.**	
Total Score/Level of Proficiency*		**5 pts.**	

* **Meeting Standard** 4–5 points (75%–100% correct) **Approaching Standard** 3 points (50–74% correct) **Strategic** 2 points (25–49% correct) **Intensive** 1 point or less (

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Rounding and Multi-Digit Addition Checkpoint

Rounding & Multi-Digit Addition Checkpoint Scoring Guide

Name

- Unit 3 Three-Digit Addition and Subtraction Checkpoint

Three-Digit Addition & Subtraction Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–c Completes three different number line sketches to model and solves a story problem that involves finding the difference between 367 and 228. *The solution is 139 in each case. See answer key for labels.*	3.NBT.2	**6 pts.** • 1 pt. for each sketch labeled correctly with the missing numbers • 1 pt. for each correct answer, noted and circled in the proper location (above the line for 1a and 1b; below the line for 1c)	
2 Models and solves 194 – 156 on an open number line. *38. Work will vary.*	3.NBT.2	**2 pts.** • 1 point for using a viable strategy that could lead to the correct answer on the number line • 1 point for the correct answer	
3a–b Estimates the results of adding and subtracting 2- and 3-digit numbers in story problem contexts. *a. No; b. Yes*	3.NBT.2	**2 pts.**	
4a Solves a 2-step story problem that involves adding 152 and 29, then finding the difference between that sum and 136. Shows work. *45 fireflies. Work will vary. Example: 152 + 29 = 151 + 30 = 181; 181 – 36 = 185 – 40 = 45*	3.OA.8 3.NBT.2	**2 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to the correct answer	
4b Chooses the equation that best represents the problem. *152 + 29 – 136 = f*	3.OA.8	**1 pt.**	
Total Score/Level of Proficiency*		**13 pts.**	

* **Meeting Standard** 10–13 points (75%–100% correct) **Approaching Standard** 7–9 points (50–74% correct) **Strategic** 4–6 points (25–49% correct) **Intensive** 3 points or less

- Unit 3 Post-Assessment

Unit 3 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
7c Chooses the equation that does *not* represent a given story problem. *637 + 674 = b*	supports 3.OA	**1 pt.**	
8a Solves a two-step story problem that involves addition and subtraction. Shows work. *295 fourth graders. Work will vary. Example: 363 – 94 is the same as 369 – 100 if you add 6 to both numbers. The answer is 269. Then add 269 + 26 = 270 + 25 = 295.*	3.OA.8 3.NBT.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see note)	
8b Writes an equation, or a pair of equations, to represent a two-step story problem. *Equations will vary. Acceptable equations include (but are not limited to) 363 – 94+ 26 = 295; (363 – 94) + 26 = 295; 363 + 26 – 94 = 295.*	3.OA.8	**1 pt.**	
9a–b Chooses two 3-digit addition combinations to solve. Shows work. *735, 96, 698, 603*	3.NBT.2	**4 pts.** (2 pts. per problem): • 1 pt. for the correct answer • 1 pt. for viable work (see note)	
10a–b Chooses two 2- or 3-digit subtraction combinations to solve. Shows work. *65, 8, 199, 57*	3.NBT.2	**4 pts.** (2 pts. per problem): • 1 pt. for the correct answer • 1 pt. for viable work (see note)	
		Subtotal page 2	
		Subtotal from page 1	
Total Score/Level of Proficiency*		**30 pts.**	

* **Meeting Standard** 23–30 points (75%–100% correct) **Approaching Standard** 15–22 points (50–74% correct) **Strategic** 8–14 points (25–49% correct) **Intensive** 7 points or less

Unit 3 Post-Assessment Scoring Guide page

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Rounds 2- and 3-digit numbers to the nearest 10. *70, 120, 530, 2860*	3.NBT.1	**4 pts.**	
2 Rounds 3- and 4-digit numbers to the nearest 100. *400, 100, 500, 2900*	3.NBT.1	**4 pts.**	
3a–b Identifies 3-digit addition and subtraction equations as true or false. *True, False*	3.NBT.2	**2 pts.**	
4a–b Completes 3-digit addition and subtraction equations by filling in the unknown number. *672, 844*	3.NBT.2	**2 pts.**	
5 Chooses two numbers from a set of four that total closest to 700. *442, 270*	supports 3.NBT	**1 pt.**	
6a Chooses two numbers from a set of four that total closest to 1,000. *560, 442*	supports 3.NBT	**1 pt.**	
6b Explains reasoning in selecting the two numbers. *Explanations will vary. Example: When I rounded the numbers, I saw that 560 was close to 600, and 442 was close to 400, and 600 + 400 = 1,000.*	supports 3.NBT	**1 pt.** for any viable explanation *The student does not have to make reference to rounding the numbers, but it's something to look for.*	
7a Compares two 3-digit numbers correctly. *The fifth graders read the most books.*	supports 3.NBT	**1 pt.**	
7b Solves a story problem that involves finding the difference between 674 and 637. Shows work. *37 more books. Work will vary.*	3.NBT.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work (see note)	
		Subtotal page 1	

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 4: Measurement and Fractions
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
3.OA.D.8 Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

3.NBT.A.2 Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
3.NF.A.1 Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a part of size 1/b.
3.NF.A.2.A Represent a fraction 1/b on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size 1/b and that the endpoint of the part based at 0 locates the number 1/b on the number line.
3.NF.A.2.B Represent a fraction a/b on a number line diagram by marking off a length 1/b from 0. Recognize that the resulting interval has size a/b and that its endpoint locates the number a/b on the number line.
3.NF.A.3.A Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.
3.NF.A.3.B Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3. Explain why the fractions are equivalent, e.g., by using a visual fraction model.
3.NF.A.3.C Express whole numbers as fractions and recognize fractions that are equivalent to whole numbers. Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.
3.NF.A.3.D Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

Supporting Standards:
3.MD.A.1 Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.
3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.
3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.
3.G.A.2 Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
● Solve two-step word problems using four operations.	● Word problems for specific operations follow typical structures that help determine which operation, sometimes more than one, to use.
● Solve one-step problems involving masses or volume that are given in the same units (using strategies and drawings)	● Measurement of mass and volume are real-world contexts for addition and subtraction situations.
● Solve word problems involving addition and subtraction of time intervals in minutes (by representing the problem on a number line diagram).	● Time is a measurement that is a real-world context for addition and subtraction situations, in which the unit is based on 60 minutes in an hour.
● Represent problems using equations with a letter standing for the unknown quantity.	● An unknown number in an equation can be represented with a letter. We can solve for the unknown in any position within an equation.
● Represent a fraction 1/b on a number line by defining the interval from 0 to 1 as the whole and partitioning into b equal parts.	● Between any two whole numbers are an infinite number of fractions which are named for the total number of equal-sized parts between the two whole numbers.
● Represent a fraction a/b on a number line.	● By partitioning a number line between two whole numbers we can locate a fraction's position.
	● Estimation can help determine if our computations are reasonable.

• Assess the reasonableness of answers using mental computation and estimation strategies.	• Numbers can be composed and decomposed into hundreds, tens, and ones in order to add to or subtract from another number.
• Fluently add and subtract within 1000 using strategies.	• A single point on a number line can be labeled as more than 1 fractions if the fractions are equivalent.
• Understand two fractions as equivalent if they are the same size or the same point on a number line.	• A fraction with a numerator equal to, or a multiple of, the denominator has a whole number equivalent.
• Recognize fractions that are equivalent to whole numbers.	• A fraction of a smaller whole is not equivalent to the same fraction of a larger whole.
• Recognize comparisons (of fractions) are only valid when the two fractions refer to the same whole.	• Fractions that represent the same part of the same whole are equivalent.
• Recognize and generate Simple equivalent fractions ½ = 2/4, 4/6 = ⅔, etc.	• Number lines, area models and bar models can be used to show equivalent fractions.
• Explain why fractions are equivalent using a visual fraction model.	• A fraction with a denominator or 1 is equivalent to a whole number.
• Express whole numbers as fractions.	• Each part of a whole can be expressed as $1/d$ of the whole, where d is the number of those parts that make up the whole.
• Express the area of each part of a whole as a unit fraction of a whole.	• Fractions with the same numerators refer to the same number of parts; fractions with the same denominators refer to the same sized parts.
	• We can use comparison symbols to show how fractions relate to each other in magnitude.
	• Drawings and number lines can support reasoning for

• Compare two fractions with the same numerator or denominator by reasoning about their size.	fraction comparisons and operations.
• Record results of comparisons with symbols >, =, <.	• Analog clocks have minute and hour hands; there are 60 minutes in the hour; each number on the clock represents one hour OR five-minute intervals.
• Justify conclusions (using visual fraction models).	• Measurement tools are specific to the type of measurement being made. Measurement units have predictable sizes that we can use to estimate volumes and masses.
• Tell and write time to the nearest minute.	• We can collect data by conducting measurement using the same unit.
• Measure time intervals in minutes.	• A line plot is a representation of frequency of data.
• Measure and estimate liquid volumes and mass of objects.	• There are many ways to partition shapes into equal areas.
• Generate measurement data by measuring lengths.	
• Show data by making a line plot.	
• Partition shapes into parts with equal areas.	

Essential Questions *What essential questions will be considered?*	Corresponding Big Ideas *What understandings are desired?*
1. How do we compare fractions?	1. Fractions of the same whole can be compared by reasoning about their size or location on a number line.
2. What is a fraction?	2. A fraction is a number that represents how many parts of a whole. It is also a division relationship between two numerical values.
3. Why is it important to be able to tell and understand time?	3. Time measurement is a means to organize and structure each day, events, and our lives.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **1.3.d Knowledge Constructor** Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
Informational Texts: • **Informational Books:** ○ Math Learning Center's #FoundItOnAmazon Virtual Measurement Bookshelf ○ Millions to Measure ○ Telling Time ○ Jim and the Beanstalk ○ Math Learning Center's #FoundItOnAmazon Virtual Time Bookshelf ○ Math Learning Center's #FoundItOnAmazon Virtual Fractions Bookshelf • **Media:** ○ Elapsed Time on a Number Line- teacher reference ○ Interactive Teaching Clock

- Math Learning Center's Measurement Pinterest Board
- Teacher tool Fraction Finder

Online Resources / Websites:

- **Math Learning Center Apps:**
  - Number Line App
  - Fractions App
  - Pattern Shapes App
- **Games:**
  - Hickory, Dickory, Clock
  - Match Analog and Digital Clocks
  - Mostly Postie
  - Pecking Order
  - Liquid Measure

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Centimeter (cm): a metric unit of length equal to 1/100 of a meter or about ⅖ of an inch.
Congruent: of the same shape *and* size; two shapes are congruent if one can be exactly superimposed onto the other using a sequence of rotations, reflections, and/or translations.
Cup: a customary unit of capacity equal to 8 fluid ounces.
Customary System: the system of measurement used in the United States; includes units for measuring length, capacity, weight, and temperature.
Data: items of information; may include facts, numbers, or measurements.
Denominator: the bottom number in a fraction, which shows into how many equal parts the whole is divided; also, the divisor.
Equation: a mathematical statement asserting that two quantities have the same value.
Fraction: a number expressed as some number of equal parts of a whole.
Gallon (gal.): a customary unit of capacity equal to 4 quarts or 16 cups or 128 fluid ounces.
Gram (g): a metric unit of mass equal to one-thousandth of a kilogram or about the weight of a standard paperclip.
Half: one part when a number, shape, or set is divided into exactly two equal parts.

Height: distance upward from a given level to a fixed point.
Inch (in.): a customary unit of length equal to 1/12 of a foot.
Kilogram (kg): a metric unit of mass equal to 1,000 grams or about 2.2 pounds.
Line Plot: a horizontal number line that uses markings (such as an X or a dot) to show data points above their values on the line.
Liquid Volume: the measure of the amount of liquid a container will hold.
Liter (l): a metric unit of capacity equal to 1,000 milliliters or about a quart.
Mass: a measure of the amount of matter in an object measured in grams, kilograms, etc.
Meter (m): a metric unit of length equal to 100 centimeters or about 39 inches.
Metric system: a system of measurement based on tens.
Milliliter (ml): a metric unit of capacity equal to one-thousandth of a liter.
Millimeter (mm): a metric unit of length equal to one-thousandth of a meter and one-tenth of a centimeter.
Numerator: the top number in a fraction, which shows how many equal parts are to be counted; also, the dividend.
Ounce (oz.): a customary unit of measure equal to one-sixteenth of a pound.
Pound (lb.): a customary unit of weight equal to 16 ounces.
Quart (qt.): a customary unit of capacity equal to one-fourth of a gallon or 4 cups or 32 fluid ounces.
Sum or Total: the result of adding two or more numbers.
Table: a collection of data that has been organized into columns and rows.
Unit fraction: a fraction with a numerator of 1.
Volume: the total number of cubic units needed to fill a three-dimensional space.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

This unit begins with measurement concepts and skills. Students tell time to the minute and solve elapsed time problems. Then the class discusses the need for measuring by reading a book about the biggest, tallest, and fastest animals in the world. At the end of the first module, students estimate, measure, and compare the masses of different objects. In the second module, students work with volume and solve measurement-related story problems. The third module introduces them to fractions, using several different models to build, compare, and investigate the relationships among unit and common fractions. A short project at the end of the unit brings it all together, as students measure lengths to fractions of an inch and display measurement data on line plots.

Learning Tasks Per Week (Including Instructional Strategies)

Week One:

Lesson One: Unit 4 Pre-Assessment
Students spend the first part of this session taking the Unit 4 Pre-Assessment. Those who complete the assessment before the end of the period choose a Work Place to do quietly.

Lesson Two: Telling Time
Students review telling time, starting with the hour, the half-hour, and then 5-minute increments. Next, they practice reading and writing time to the minute on analog and digital clocks, and the teacher introduces the Work Place game Tic-Tac-Tock for ongoing practice. If time remains, students go to Work Places. Work Place 4A Tic-Tac-Toc Player 1 rolls two blue 1–6 dice, finds the sum of the numbers rolled, and sets the hour hand on a student clock to that number. Then he rolls the green 1–6 die and the white 4–9 die together and multiplies the numbers shown to find their product. He explains how he found the product and sets the minute hand to that number. When both players agree on the time, Player 1 looks for a clock on the record sheet whose description matches the time. Players take turns until one player fills in three clocks in a row.

Lesson Three: Time on a Number Line
Students reflect on the Unit 4 Pre-Assessment. Then, the teacher records landmark times on a timeline for them to get a sense of how the time in a day fit together. Students use a number line to determine the elapsed time of common daily activities. Finally, partners work together to solve problems involving elapsed time.

Lesson Four: Measurement-Big, Strong, Fast
Students are introduced to scale and referents when discussing the book Biggest, Strongest, and Fastest. The teacher explains the difference between the metric and U.S. customary systems of measurement, and students work with metric measures of grams, kilograms, milliliters, and liters.

Lesson Five: Measuring Mass
Students learn about the difference between mass and weight and then use pan balance scales to estimate, measure, and solve problems about mass. In any remaining time, they go to Work Places.
Students are introduced to scale and referents when discussing the book Biggest, Strongest, and Fastest. The teacher explains the difference between the metric and U.S. customary systems of measurement, and students work with metric measures of grams, kilograms, milliliters, and liters.

Week Two:

Lesson Six: Estimate, Measure and Compare the Mass
Students estimate the mass of different items and then use a pan balance scale, metric measures, gram cubes, and other objects to find the actual mass.

Lesson Seven: Measuring Liquid Volume
This session begins with a quick checkpoint on time. Then, students use containers of different capacities to estimate, measure, and solve problems about liquid volume and capacity.

Lesson Eight: Measurement Scavenger Hunt
The teacher introduces a new Work Place activity, Measurement Scavenger Hunt. Students then spend the rest of the session visiting Work Places. Work Place 4B Measurement Scavenger Hunt Players work together to make, pour or find certain measurements. They spin two spinners—a measurement spinner indicating mass, volume, or length and a quantity spinner indicating 100, 250, 500, or 750 grams, milliliters, or millimeters. Students try to mold clay, pour water, or search for an object that matches the length they spun on the quantity spinner. Then they find the actual measurement to see how close they came and record the results to fill up their record sheet.

Lesson Nine: Measurement Story Problems
The teacher introduces Work Place 4C Target One Thousand by playing a couple of rounds with the class. This game provides intensive practice with place value and 3-digit computation. Then, the teacher shares a set of measurement-related story problems with the class and works with students to review key addition and subtraction strategies before they go to work. Work Place 4C Target One Thousand Players take turns drawing 8 Number Cards, and then each chooses 6 of these cards to make two 3-digit numbers with a sum as close to 1,000 as possible (over or under). Each player finds the exact difference between their sum and 1,000. After 3 rounds, each player adds their differences, and the player with the lower total wins.

Lesson Ten: More Measurement Problems
This session begins with a math forum in which students share their work from Session 3. The discussion centers around selecting and using the correct operation, as well as choosing effective models and strategies. After the forum, students work in pairs on measuring story problems that require more than one step and one operation to solve.

Week 3:

Lesson Eleven: Multi-Step Measurement Problems Forum

Students share their work with multi-step measurement problems in a math forum. Then, they spend the remainder of the session in Work Places. The teacher pulls small groups of students to provide differentiated instruction as needed.

Lesson Twelve: Fair Shares, Unit Fractions
Students complete a checkpoint on measurement and then begin a multi-session investigation of fractions. Today, they share imaginary cookies with varying numbers of people by folding paper rectangles to create and label halves, thirds, fourths, sixths, and eighths. The class compares the different unit fractions, noting that fractions do not have to be congruent to be equivalent. The teacher displays a rectangle divided into four unequal parts and asks students whether each part can be called a fourth.

Lesson Thirteen: Comparing and Ordering Unit Fractions
Students compare and order unit fractions from greatest to least, first using the paper rectangles they folded and labeled last session, and then a set of paper “licorice whips” presented later in the session. The teacher guides students toward the generalization that the larger the number of people sharing something, the smaller the share. This is established after the paper cookies are ordered, and it is tested again after the licorice whips have been folded, cut, labeled, and ordered.

Lesson Fourteen: Pattern Block: Fractions
Students investigate the fractions represented by several of the pattern blocks, and then by combinations of pattern blocks when the hexagon is assigned a value of 1. The class discusses the different values of each block. Then students learn and play Hexagon Spin & Fill, which will later become a Work Place. Work Place 4D Hexagon Spin & Fill Each player in turn spins a spinner labeled with fractional amounts. The player takes the correct pattern blocks and sets them on his first hexagon on the record sheet. At the end of each turn, the player must make trades to ensure that he always has the fewest number of patterns blocks possible. Players continue to take turns spinning and collecting pattern blocks until one of them has filled all three hexagons on their section of the record sheet.

Lesson Fifteen: Fractions as Distances
Students create a class number line marked with 0 at one end and 1 at the other and work together to place several fractions along the line. Then they each create their own number line and practice locating various points along it, including 1/2, 1/4, and 3/4.

Week 4:

Lesson Sixteen: Fractions on the Number Line
Today, students work together to add some more fractions to their class number line. Then they work briefly with the double number lines they constructed last session before sketching some fractions on their own number line diagrams.

Lesson Seventeen: Creating and Measuring Beanstalks
Students create a paper beanstalk with a partner and measure its parts to the nearest half- and quarter inch. In two sessions that follow, they use their measurements to create two different line plots and answer questions about their data.

Lesson Eighteen: Gathering and Recording Beanstalk Data
Today, students work in pairs to gather and record information about the beanstalks they made last session. During the latter part of the session, students work together to create a line plot displaying some of the data they collected.

Lesson Nineteen: Beanstalk Leaf Line Plots
Students work in pairs to construct line plots showing the lengths of all the leaves on their beanstalks, and then answer some questions about their data displays. They go to Work Places as they finish the assignment.

Lesson Nineteen: Beanstalk Leaf Line Plots
Students work in pairs to construct line plots showing the lengths of all the leaves on their beanstalks, and then answer some questions about their data displays. They go to Work Places as they finish the assignment.

Lesson Twenty: Unit 4 Post-Assessment
Students take the Unit 4 Post-Assessment and then visit Work Places.

Interdisciplinary / Real World / Global Connections

- Connecting elapsed time and problems involving solving for an unknown in an elapsed time problem to a timeline is a real-world application of the basic number line that students have been using for several years. This connection helps students see time as linear, as an extension of the additive/subtractive principles they are familiar with and gives them a model for moving forward and backward in time in a visual way versus the analog clock model.
- Establishing fractions as a fair share model by using cookies (part-whole fractions) and licorice (linear fractions) gives students a context for seeing fractions as numbers that are familiar as opposed to their abstract numeral representations with a numerator and denominator. These contexts also provide opportunity for establishing the meaning of the numerator and denominator- a critical piece of the fractions third grade standards.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Differentiation
Challenge: ● Create fraction pattern block puzzles and develop answer keys. ● Provide students who are secure in telling time to the minute opportunities for problem solving involving elapsed time. ● Extension activities aligned with Bridges lessons are included in each module
Support: ● Ensure instructional materials are systematic and explicit. They should include numerous clear models of easy and difficult problems, with accompanying teacher think-alouds. ● Provide students with opportunities to solve problems in a group and communicate problem-solving strategies. ● Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type. ● Students should work with visual representations of mathematical ideas. ● If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulations first. ● Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they

shouldn't be told how to reach the solution.
- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

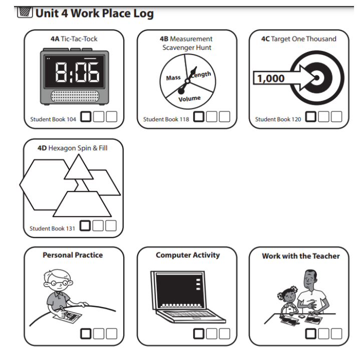
MLL (Multilingual Learners)**:**
- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words.
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 4 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 4 Time Checkpoint
- Unit 4 Measurement Checkpoint
- Unit 4 Post-Assessment

Unit 4 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible
1a Solves a story problem that involves addition of mass in grams. Shows work; labels answer with correct units. *901 grams (g); work will vary. Example: 502 + 399 = 501 + 400 = 901.*	3.NBT.2 3.MD.2	**3 pts.** • 1 pt. for the correct answer • 1 pt. for viable work that could lead to the correct answer • 1 pt. for labeling answer with correct units
1b Solves a story problem that involves subtraction of liquid volume in liters. Shows work; labels answer with correct units. *302 liters (l); work will vary. Example: 600 – 298 = (600 + 2) – (298 + 2); 602 – 300 = 302.*	3.NBT.2 3.MD.2	**3 pts.** *See scoring guide for problem 1a above.*
1c Solves a story problem that involves multiplication (or repeated addition) of length in meters. Shows work; labels answer with correct units. *117 meters (m); work will vary. Example: 10 × 13 = 130; 130 – 13 = 117.*	3.NBT.2 3.MD.2	**3 pts.** *See scoring guide for problem 1a above.*
2a Solves a 2-step story problem that involves multiplication and addition of mass in kilograms. Shows work; labels answer with correct units. *90 kilograms (kg); work will vary. Example: 6 × 11 = 66 and 2 × 12 = 24; 66 + 24 = 90.*	3.OA.8 3.MD.2	**3 pts.** *See scoring guide for problem 1a above.*
2b Chooses the equation that best represents the problem. *Choice 1: (6 × 11) + (2 × 12) = m*	3.OA.8	**1 pt.**
3a–c Chooses the type of measure needed for the task, and the most appropriate unit. *3a) volume, liters; 3b) length, centimeters; 3c) mass/grams*	3.MD.2	**6 pts.** (2 pts. per problem): • 1 pt. for identifying the correct type of measurement • 1 pt. for identifying most appropriate unit
4 Reads time to the minute on an analog clock and records it on a digital clock. *7:10, 2:37*	3.MD.1	**2 pts.**
5 Reads time to the minute on a digital clock and draws the hands in on an analog clock to match. *5:48 and 11:13. See answer key.*	3.MD.1	**2 pts.**
		Subtotal page 1

Unit 4 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible
6 Solves a story problem that involves calculating elapsed time. Shows work. *4:15; work will vary.*	3.MD.1	**2 pts.** • 1 pt. for the correct answer • 1 pt. for showing work that could lead to the correct answer
7a–b Demonstrates understanding that one fourth of a small whole and one fourth of a large whole are not equal. *Either option is valid as long as the reasoning shows understanding; students' explanations will vary. Example: I chose Sandwich A because I'm really hungry.*	3.NF.3d	**1 pt.** for an explanation that indicates understanding that the two halves are not the same size.
8 Compares fractions with like numerators and with like denominators. Uses symbols >, =, or < to show comparisons. *[>, <, <, >]*	3.NF.3d	**4 pts.**
9a–b Partitions a shape into the number of pieces required to form the designated fraction; shades in fraction correctly. *See answer key.*	3.NF.1 3.G.2	**2 pts.**
10 Places fractions and whole numbers correctly on an open number line. *See answer key.*	3.NF.2	**4 pts.** • 1 pt. for each number placed along the line with reasonable accuracy, both in terms of its place in the order, and its distance from 0 relative to the other numbers
11 Demonstrates understanding that fractions have to be equal parts of the same whole. *No. Explanations will vary.*	3.NF.1	**2 pts.** • 1 pt. for the correct answer (no) • 1 pt. for a viable explanation
12 Demonstrates understanding that the greater the denominator, the smaller the size of the fraction. *No. Explanations will vary.*	3.NF.1	**2 pts.** • 1 pt. for the correct answer (no) • 1 pt. for a viable explanation
13a–d Compares fractions based on their size; recognizes equivalent fractions. *False, false, true, true. Sketches will vary.*	3.NF.3a 3.NF.3b 3.NF.3c	**8 pts.** (2 per problem:) • 1 pt. for the correct answer • 1 pt. for a sketch that demonstrates understanding of the situation
		Subtotal page 2
		Subtotal from page 1
Total Score/Level of Proficiency*		**48 pts.**

* **Meeting Standard** 36–48 points (75%–100% correct) **Approaching Standard** 24–35 points (50–74% correct) **Strategic** 12–23 points (25–49% correct) **Intensive** 11 points or less (24% or less correct)

Time Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible
1a–b Reads time to the nearest minute. *1:20, 4:45*	3.MD.1	**2 pts.**
2a–b Writes time to the nearest minute. *8:13, 12:48; see answer key.*	3.MD.1	**2 pts.**
3a–b Solves a story problem involving addition and subtraction of time intervals in minutes. *30 minutes; 4:00 p.m.; work will vary. Example: 5 + 10 + 3 + 12 = 30 minutes; 30 minutes before 4:30 is 4:00.*	3.MD.1	**4 pts.** (2 pts. per problem) • 1 pt. for the correct answer to each part of the problem • 1 pt. for showing work for each part of the problem that could lead to the correct answer
Total Score/Level of Proficiency*		**8 pts.**

* **Meeting Standard** 6–8 points (75%–100% correct) **Approaching Standard** 4–5 points (50–74% correct) **Strategic** 2–3 points (25–49% correct) **Intensive** 1 point or less (24% or less correct)

Measurement Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible
1a–c Measures volume in milliliters, mass in grams, and length in centimeters. Labels the measurements with the correct units. *500 milliliters, 26 centimeters, 80 grams*	3.MD.2	**6 pts.** (2 pts. per problem:) • 1 pt. for the correct answer • 1 pt. for labeling the answer with the correct unit
2a–c Identifies the attribute to be measured, and chooses the most appropriate unit to do so. *length/centimeters; volume/milliliters; mass/kilograms*	3.MD.2	**6 pts.** (2 pts. per problem): • 1 pt. for identifying the correct type of measurement • 1 pt. for identifying most appropriate unit
3 Solves a two-step measurement story problem involving mass given in grams using addition (or multiplication) and subtraction. *117 grams; work will vary. Example: 112 + 112 = 224, and 224 + 112 = 336 grams for the frogs. 453 – 336 = 117 grams*	3.OA.8 3.MD.2	**3 pts.** • 1 pt. for the correct answer • 1 pt. for viable work that could lead to the correct answer • 1 pt. for labeling the answer with the correct units
Total Score/Level of Proficiency*		**15 pts.**

* **Meeting Standard** 12–15 points (75%–100% correct) **Approaching Standard** 8–11 points (50–74% correct) **Strategic** 4–7 points (25–49% correct) **Intensive** 3 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 5: Multiplication, Division and Area
Pacing	5 Weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
3.OA.1 Interpret products of whole numbers; write story problems or describe problem situations to match a multiplication expression or equation.
3.OA.2 Interpret quotients of whole numbers; write story problems or describe problem situations to match a division expression or

equation.
3.OA.3 Solve multiplication and division story problems with products to 100 involving situations of equal groups, arrays, and measurement quantities.
3.OA.4 Solve for the unknown in a multiplication or division equation involving 3 whole numbers.
3.OA.6 Solve division problems by finding an unknown factor.
3.OA.7 Fluently multiply and divide with products and dividends to 100 using strategies.
3.OA.8 Solve two-step story problems using multiplication and division.

Supporting Standards:

3.MD.5a Demonstrate an understanding that a square with a side length of 1 unit is called a 'unit square" and has 1 square unit of area.
3. MD.5a Demonstrate an understanding that unit squares can be used to measure the areas of other plane figures.
3. MD.5b Demonstrate an understanding that a plane figure that can be covered without gaps or overlaps by n unit squares has an area of n square units.
3.MD.6 Measure the area of a plane figure by counting the number of square units that cover it, with no gaps or overlaps.
3.MD.7a Find the area of a rectangle with whole-number side lengths by tiling it and show that the area is the same as would be found by multiplying the side lengths.
3.MD.7b Find the area of a rectangle by multiplying its side lengths; represent the product of two numbers as the area of a rectangle with side lengths equal to those two numbers.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Interpret products and quotients of whole numbers. 2. Write multiplication story problems to match a	

multiplication expression or equation.

3. Write division story problems to match a division expression or equation.
4. Solve multiplication and division story problems with products to 100.
5. Solve for an unknown in a multiplication or division equation with 3 whole numbers.
6. Fluently multiply and divide with products and dividends to 100.
7. Select equations with a letter representing an unknown quantity in one and two-step story problems.
8. Find the area of a plane figure using area tiles.
9. Find an area of a rectangle by multiplying the length of its sides.
10. Solve division problems by finding an unknown factor.
11. Measure the area of a plane figure by counting the number of square units that cover it, with no gaps or overlaps.

1. A product is the answer to a multiplication problem and is found by multiplying two factors. A quotient is the answer to a division problem and is found by dividing a product by one of its factors.
2. There are several structures of multiplication problems.
3. There are several structures of division problems.
4. Multiplication and division story problems can be modeled with arrays and area models.
5. Multiplication and division are inverse operations and related facts can be used to solve unknown facts.
6. Strategies can be used to determine unknown facts.
7. Equations can be written with letters that represent unknown quantities.
8. A plane figure can be covered without any gaps or overlaps with *n* unit squares and has an area of *n* square units.
9. The formula for calculating the area of a rectangle is length times width.
10. Multiplication and division are inverse operations and

	related facts can be used to solve unknown facts. 11. A plane figure can be covered without any gaps or overlaps with *n* unit squares has an area of *n* square units.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What does it mean to divide? 2. How is division related to multiplication? 3. How are multiplication and division like and different from addition and subtraction? 4. How does the array model relate to the operations of addition, multiplication, and division?	1. Division is an operation in which quantities are shared equally either in a known number of groups (partitive division) or in groups of a certain size (quotative division). 2. Division is the inverse operation of multiplication. 3. Like addition and subtraction, multiplication and division are inverse operations. Knowing how inverse operations are made up of related facts, called fact families, allows students to build on their knowledge of multiplication facts to become fluent with division facts. 4. In an array model number being multiplied correspond to the dimensions of a rectangle and the product of those numbers corresponds to the area of that rectangle, thus bridging the gap between the array model, repeated addition, and area as a model for multiplication and as a measurement of two-dimensional shapes.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

1.3.d Knowledge Constructor
Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

Informational Texts:

- **Informational Books:**
  - Math Learning Center #FoundItOnAmazon book collection
  - What Comes in 2s, 3s, and 4s?
  - The Best of Times
  - How Long or How Wide?
- **Media:**
  - Arrays Reference
  - Math Learning Center Multiplication/Division Pinterest board
  - Grouping- a teacher tool for interactive whiteboards
  - Sharing- a teacher tool for interactive whiteboards

Online Resources / Websites:

- **MLC Apps:**
  - Number Frames
  - Number Pieces
  - Partial Product Finder
- Games:
  - Bunny Times
  - Drag Race Division
  - Fractris
  - Arithmetic Four
  - Grand Prix Multiplication
  - The Ruler Game
  - Zoo Designer

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Area: the total number of square units needed to cover a two-dimensional surface.
Array: an arrangement consisting of equal rows and equal columns.
Customary System: the system of measurement used in the United States; includes units for measuring length, capacity, weight, and temperature.
Dimension: the length, width, or height of a figure.
Divide: to break or split into equal parts; to determine how many times one number goes into another.
Dividend: the number that will be divided in a division problem.
Divisor: the number in a division problem that divides the dividend.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs.
Factor: a whole number that divides evenly into another number.
Multiply: to find the product of two or more factors.
Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array.
Quotient: the result or answer in division; the number of times one quantity goes into another.
Rectangle: a two-dimensional (flat) shape with two pairs of parallel sides 94 sides total) and 4 right angles.
Remainder: the number left over when one whole number is divided by another whole number.
Square Foot (ft.): a unit of area measurement equal to a square measuring one foot on each side.
Square Inch (in.): a unit of area measurement equal to a square measuring one inch on each side.
Square Unit: a square with sides that measure 1 unit, used to measure area.
Square Yard (yd.): a unit of area measurement equal to a square measuring one yard on each side.
Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Unit 5 returns to the study of multiplication, especially as it relates to division. Students again build arrays but use them to model and solve division as well as multiplication problems. Story problems play a major role in the first two modules, helping students to connect their everyday experiences with division to more formal mathematical concepts. As they solve and pose story problems, students encounter two different interpretations of division—sharing and grouping—and have numerous opportunities to build understandings of both. Much of the work in Modules 2 and 3 revolves around fact families, while Module 4 features an introduction to area, a topic that will be revisited in Unit 6.

Week 1:
This week's lessons formally introduce students to division, working from what they already know about multiplication to understand division as the inverse operation, just as subtraction is the inverse of addition. After taking the unit pre-assessment, students work together to make a class chart about things that come in fours. In the second lesson, the teacher guides them in labeling the class chart with multiplication and division equations and in beginning to link the two operations. The rest of the sessions provide numerous opportunities to understand the meaning of both operations and how they relate to each other, via arrays and story problems set in the context of a game store.

Lesson One: Unit 5 Pre-Assessment
Students spend the first part of this session taking the Unit 5 Pre-Assessment. Then in preparation for an activity that will help them connect multiplication and division, they brainstorm a list of things that come in fours. They select one of the ideas—four-wheeled vehicles, for instance—by class vote. Then each student draws a picture of the selected idea and mounts it on a class chart for use next session.

Lesson Two: Connecting Multiplication and Division
After students share observations about the Fours Chart from the previous session, the teacher works with the class to label the chart with multiplication and division equations. Students then complete a related assignment and go to Work Places when they're finished.

Lesson Three: Multiplication and Division Arrays
After reflecting on their unit pre-assessments from Session 1, students build and discuss rectangular arrays to represent multiplication and division story problems. Then they make an entry about division in their journals. As they finish, they go to Work Places.

Lesson Four: Game Store Story Problems, Part 1
This is the first of three consecutive sessions that focus on solving and posing multiplication and division story problems based on a Game Store theme. In today's session, students work together to solve a division problem, and then work independently in their journals on a second problem. After sharing their solutions and strategies for the second problem, students spend any time remaining in the session at Work Places.

Lesson Five: Game Store Story Problems, Part 2
In the second of three sessions devoted to game store problems, students solve and share their strategies for two more division problems, one that involves sharing and one that involves the grouping interpretation of division. Toward the end of the session, students begin to create their own story problems about the game store for their classmates to solve.

Lesson Six: Game Store Story Problems, Part 3
Students organize their solutions for a story problem on a specially designed problem-solving sheet. They estimate a reasonable answer for the problem, write an equation to represent the situation, explain the task briefly, and then show their thinking in pictures, numbers, and words. This is identical to the format they will use in Work Place 5A Solving Game Store Problems, introduced today. In the second part of the session, students brainstorm guidelines for writing clear solutions, are introduced to the new Work Place, and then complete the story problems they began last session.

Work Place 5A Solving Game Store Problems: The student chooses from the collection of story problems written by her classmates. She records a reasonable estimate and an equation to match the problem. Then she solves the problem and shows her thinking. Last, she edits her work to be sure it meets class guidelines.

Week 2:
Over the course of the four lessons in the remainder of week 2, students continue to explore two different interpretations of division— sharing and grouping—by solving story problems that elicit one interpretation or the other, and then sharing and discussing their work as a class. The teacher also introduces fact families—sets of related facts that further help students understand the connection between multiplication and division.

Lesson Seven: Division Story Problems and Fact Families
Students start the session by discussing and solving a division story problem. As they discuss the problem, the teacher introduces fact families to help students better understand the connection between multiplication and division. Students solve two more story problems in pairs and spend the remainder of the session at Work Places.

Lesson Eight: Division Story Problems Forum
Today's session opens with a math forum, during which selected students share their thoughts with the class about the problems they solved last session. During the forum, the class discusses the sharing and grouping interpretations of division. Following the forum, the teacher introduces Work Place 5B Scout Them Out and then sends students out to Work Places if time permits.

Work Place 5B Scout Them Out: The student chooses one of eight sheets to complete. Each sheet features two of the multiplication strategies introduced in Unit 2. The student finds all the multiplication facts on the sheet that match the first strategy, circles them in blue, and writes the answers to those facts. Then he identifies all the multiplication facts on the sheet that match the second strategy, circles them in red, and writes the answers. Finally, he solves the division problems, using answers to the multiplication problems to help.

Lesson Nine: What's Missing? Bingo
Today, students play a bingo game in which they solve for an unknown factor, divisor, or dividend and then cover the solution on their bingo boards. In solving for the unknown numbers, students may use a variety of strategies, including fact recall, working from facts they already know to derive answers for those they don't, looking at rectangular arrays, and skip-counting backward and forward. At the end of the game, the teacher selects one equation and asks students to complete the fact family for that fact. Students then complete a related assignment in their Student Books and go out to Work Places.

Lesson Ten: True or False?
This session opens with a brief checkpoint on multiplication and division. Then students work together to evaluate a series of multiplication and division equations, reviewing the meaning of the equal sign in the process. After that, they complete a related assignment in their Student Books independently and go to Work Places as they finish.

Week 3:
During Week 3, students again investigate two different interpretations of division—sharing and grouping—by solving story problems that elicit one interpretation or the other, and then sharing and discussing their work as a class. The teacher also introduces two new division Work Places, Line 'Em Up and Division Capture. The first of these is designed to deepen students' understanding of the operation, while the second provides practice with basic division facts.

Lesson Eleven: Sharing and Grouping Problems
In today's lesson, students first pose story problems that match related multiplication and division expressions, and then work in pairs to solve a set of division story problems. This set features three pairs of division problems that involve the same numbers but elicit two different interpretations of division—sharing and grouping. The teacher circulates to observe, provide support, and

challenge, and select students to share the work next session during a math forum. **Lesson Twelve: Sharing and Grouping Forum** Today’s session opens with a math forum, during which selected students share their thinking with the class about the problems they solved last session. During the forum, students continue to investigate and discuss the sharing and grouping interpretations of division. After the forum, they complete a related assignment in their Student Books, and go to Work Places as they finish. **Lesson Thirteen: Line ‘Em Up** Today, the teacher plays a new game with the class, introduces it as a Work Place, and then sends students out to do Work Places. The game of Line ’Em Up reinforces the use of an array model for division, provides an opportunity for students to deepen their understanding of the operation, and produces interesting patterns that will engage even those students who are already proficient with division. **Work Place 5C Line ’Em Up:** Each player rolls two dice, multiplies the two numbers, and then divides that number of bugs (modeled with tiles) into 2, 3, 4, 5, and finally 6 rows. Players record the results of each division, including any remainders. At the end of the game, both players add up their remainders and the player with the greater sum wins. **Lesson Fourteen: Division Capture** Today, the teacher plays another new game with the class, introduces it as a Work Place, and then sends students out to do Work Places. Division Capture provides practice with basic division facts in the context of an engaging game that involves strategy as well as luck. **Work Place 5D Division Capture**: Players take turns spinning a number to complete a division combination on a grid. Each player uses a different color, and once all equations are completed, they circle their own equations that fall in a row to score points.
Weeks 4 and 5: This module introduces the concept of area, which will be addressed in greater depth during Unit 6. Over the course of five sessions, students come to understand that area is an attribute of plane figures such as rectangles and squares and is measured in square units. After measuring paper rectangles and surfaces around the classroom in nonstandard units, students move into estimating and measuring area in customary units: square inches, square feet, and square yards. In lessons 18 and 19, they begin to investigate the link between area and multiplication, discovering that the area of a rectangle can be efficiently calculated by multiplying its side

lengths. Students take the Unit 5 Post-Assessment in lesson 20.

Lesson Fifteen: Paper Rectangles
This is the first of five sessions related to the area. After completing a brief checkpoint on division, students explore the concept of area by covering four different paper rectangles with square tile units and then copying them onto grid paper.

Lesson Sixteen: Finding Areas Large and Small
Students use construction paper squares to find the area of several different classroom surfaces. They also determine the area of several smaller rectangles that are already marked with square units.

Lesson Seventeen: Measuring Area in Customary Units
Students consider the fact that area is usually measured in standard, or commonly agreed upon, units. They measure the dimensions of a colored tile to find that it has an area of 1 square inch. After that, the teacher displays two squares of paper and works with the class to find the area of each. Students brainstorm some items that might be best measured in each of these units and then measure the cover of their student journal in square inches.

Lesson Eighteen: Rainbow Rectangles
Students estimate and measure the area of paper rectangles in square inches, working toward increasingly efficient methods, such as multiplying the side lengths.

Lesson Nineteen: Adding Areas
After sharing what they've learned about the area so far, students decompose a rectangle into smaller regions and discover that the sum of the areas of the smaller parts equals the area of the original rectangle. Then they solve a story problem that involves adding two areas. The teacher solicits students' solutions to the problem and invites volunteers to share their thoughts.

Lesson Twenty: Unit 5 Post-Assessment
Students take the Unit 5 Post-Assessment and then go to Work Places.

Interdisciplinary / Real World / Global Connections

- Measuring and calculating areas are real-world applications of multiplicative situations.
- Developing an understanding of the area model and its relationship to multiplication and division of whole numbers lays the

foundation for multiplying polynomials in algebra.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☐ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- For students who are demonstrating facilities with basic facts, increase the numbers. Encourage these students to build/model area models instead of the array model.
- In area problems have students draw triangles or parallelograms on grid paper or on geoboards instead of rectangles and ask students to measure with square area tiles to determine area.
- Using tangram pieces the square is 1 square unit. Have students determine the area of the other shapes.
- Encourage students to share their thinking aloud during work places and ask them to generalize the patterns and strategies they are noticing in the games.

Support:

- Suggest specific work places for students who need to revisit previously learned skills.
- Encourage students counting by 1s to increase their set counting to 2s or 3s, giving practice to beginning multiplicative

thinking.

- Ensure instructional materials are systematic and explicit. They should include numerous clear models of easy and difficult problems, with accompanying teacher think-alouds.
- Provide students with opportunities to solve problems in a group and communicate problem-solving strategies.
- Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type.
- Students should work with visual representations of mathematical ideas.
- If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulations first.
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution.
- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

MLL (Multilingual Learners)**:**

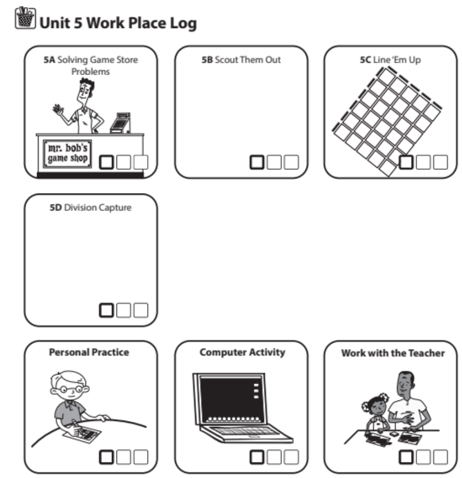
- For students who are struggling to understand the questions, read through the problems with students, rephrasing, providing visuals and/or realia whenever possible. Ask students to restate directions to be sure the tasks are clear.
- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Have pairs of MLL students observe another pair of students playing work places before playing it themselves.
- Have pairs of MLL students sit with another pair of students as they play in a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

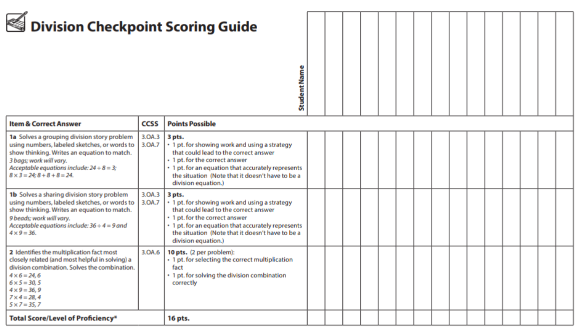
Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 5 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

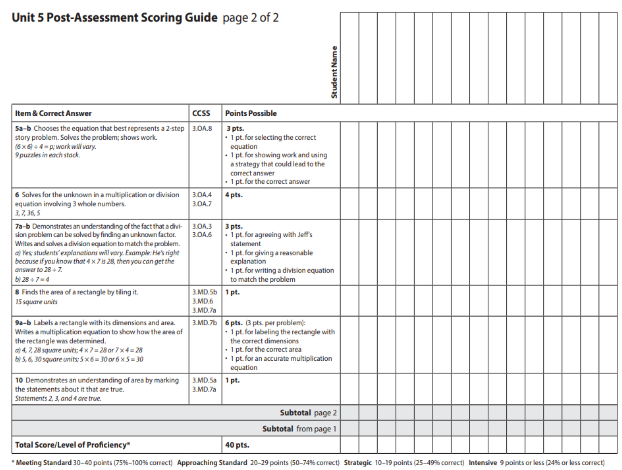
- Multiplication and Division Checkpoint
- Division Checkpoint
- Unit 5 Post-Assessment



Division Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Solves a grouping division story problem using numbers, labeled sketches, or words to show thinking. Writes an equation to match. *3 bags; work will vary.* *Acceptable equations include: $24 \div 8 = 3$; $8 \times 3 = 24$; $8 + 8 + 8 = 24$.*	3.OA.3 3.OA.7	**3 pts.** • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer • 1 pt. for an equation that accurately represents the situation (Note that it doesn't have to be a division equation.)	
1b Solves a sharing division story problem using numbers, labeled sketches, or words to show thinking. Writes an equation to match. *9 beads; work will vary.* *Acceptable equations include: $36 \div 4 = 9$ and $4 \times 9 = 36$.*	3.OA.3 3.OA.7	**3 pts.** • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer • 1 pt. for an equation that accurately represents the situation (Note that it doesn't have to be a division equation.)	
2 Identifies the multiplication fact most closely related (and most helpful in solving) a division combination. Solves the combination. *$4 \times 6 = 24$, 6* *$6 \times 5 = 30$, 5* *$4 \times 9 = 36$, 9* *$7 \times 4 = 28$, 4* *$5 \times 7 = 35$, 7*	3.OA.6	**10 pts.** (2 per problem): • 1 pt. for selecting the correct multiplication fact • 1 pt. for solving the division combination correctly	
Total Score/Level of Proficiency*		**16 pts.**	

* **Meeting Standard** 12–16 points (75%–100% correct) **Approaching Standard** 8–11 points (50–74% correct) **Strategic** 4–7 points (25–49% correct) **Intensive** 3 points or less (24% or less correct)



Unit 5 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
5a–b Chooses the equation that best represents a 2-step story problem. Solves the problem; shows work. *$(6 \times 6) \div 4 = p$; work will vary.* *9 puzzles in each stack.*	3.OA.8	**3 pts.** • 1 pt. for selecting the correct equation • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer	
6 Solves for the unknown in a multiplication or division equation involving 3 whole numbers. *3, 7, 36, 5*	3.OA.4 3.OA.7	**4 pts.**	
7a–b Demonstrates an understanding of the fact that a division problem can be solved by finding an unknown factor. Writes and solves a division equation to match the problem. *a) Yes; students' explanations will vary. Example: He's right because if you know that 4×7 is 28, then you can get the answer to $28 \div 7$.* *b) $28 \div 7 = 4$*	3.OA.3 3.OA.6	**3 pts.** • 1 pt. for agreeing with Jeff's statement • 1 pt. for giving a reasonable explanation • 1 pt. for writing a division equation to match the problem	
8 Finds the area of a rectangle by tiling it. *15 square units*	3.MD.5b 3.MD.6 3.MD.7a	**1 pt.**	
9a–b Labels a rectangle with its dimensions and area. Writes a multiplication equation to show how the area of the rectangle was determined. *a) 4, 7, 28 square units; $4 \times 7 = 28$ or $7 \times 4 = 28$* *b) 5, 6, 30 square units; $5 \times 6 = 30$ or $6 \times 5 = 30$*	3.MD.7b	**6 pts.** (3 pts. per problem): • 1 pt. for labeling the rectangle with the correct dimensions • 1 pt. for the correct area • 1 pt. for an accurate multiplication equation	
10 Demonstrates an understanding of area by marking the statements about it that are true. *Statements 2, 3, and 4 are true.*	3.MD.5a 3.MD.7a	**1 pt.**	
		Subtotal page 2	
		Subtotal from page 1	
Total Score/Level of Proficiency*		**40 pts.**	

* **Meeting Standard** 30–40 points (75%–100% correct) **Approaching Standard** 20–29 points (50–74% correct) **Strategic** 10–19 points (25–49% correct) **Intensive** 9 points or less (24% or less correct)

Unit 5 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–d Identifies and solves the equation that best matches each of 4 different multiplication and division story problems. *a) 9 × 5 = 45 b) 40 ÷ 8 = 5* *c) 8 × 5 = 40 d) 45 ÷ 5 = 9*	3.OA.3 3.OA.7	**8 pts.** (2 pts. per problem): • 1 pt. for choosing the correct equation • 1 pt. for solving the equation correctly	
2a–b Solves a multiplication and a division equation. Writes a story problem to match each equation. *a) 36; students' story problems will vary. Example: I had 9 boxes. I put 4 books in each box. How many books in all?* *b) 7; students' story problems will vary. Example: TJ has 21 football cards. He put them into 3 equal rows on his wall. How many cards in each row?*	3.OA.1 3.OA.2 3.OA.7	**4 pts.** (2 pts. per problem) • 1 pt. for the correct answer • 1 pt. for a story problem that matches	
3 Writes a fact family of 2 multiplication and 2 division equations to describe a 4-by-7 array. *4 × 7 = 28 7 × 4 = 28* *28 ÷ 4 = 7 28 ÷ 7 = 4*	3.OA.1 3.OA.2	**4 pts.** • 1 pt. for each correct equation	
4a Solves a division story problem using numbers, labeled sketches, or words to show thinking. Writes an equation to match. *6 stacks; work will vary. Acceptable equations include: 60 ÷ 10 = 6; 60 – 10 – 10 – 10 – 10 – 10 – 10 = 0; 6 × 10 = 60; 10 × 6 = 60; 10 + 10 + 10 + 10 + 10 + 10 = 60.*	3.OA.3 3.OA.7	**3 pts.** • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer • 1 pt. for an equation that accurately represents the situation (does not have to be a division equation)	
4b Solves a multiplication story problem using numbers, labeled sketches, or words to show thinking. Writes an equation to match. *35 board games; work will vary.* *Acceptable equations include: 7 × 5 = 35; 5 × 7 = 35; 5 + 5 + 5 + 5 + 5 + 5 + 5 = 35; 7 + 7 + 7 + 7 + 7 = 35.*	3.OA.3 3.OA.7	**3 pts.** • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer • 1 pt. for an equation that accurately represents the situation (does not have to be a multiplication equation)	
		Subtotal page 1	

Unit 5 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
5a–b Chooses the equation that best represents a 2-step story problem. Solves the problem; shows work. *(6 × 6) ÷ 4 = p; work will vary.* *9 puzzles in each stack.*	3.OA.8	**3 pts.** • 1 pt. for selecting the correct equation • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer	
6 Solves for the unknown in a multiplication or division equation involving 3 whole numbers. *3, 7, 36, 5*	3.OA.4 3.OA.7	**4 pts.**	
7a–b Demonstrates an understanding of the fact that a division problem can be solved by finding an unknown factor. Writes and solves a division equation to match the problem. *a) Yes; students' explanations will vary. Example: He's right because if you know that 4 × 7 is 28, then you can get the answer to 28 ÷ 7.* *b) 28 ÷ 7 = 4*	3.OA.3 3.OA.6	**3 pts.** • 1 pt. for agreeing with Jeff's statement • 1 pt. for giving a reasonable explanation • 1 pt. for writing a division equation to match the problem	
8 Finds the area of a rectangle by tiling it. *15 square units*	3.MD.5b 3.MD.6 3.MD.7a	**1 pt.**	
9a–b Labels a rectangle with its dimensions and area. Writes a multiplication equation to show how the area of the rectangle was determined. *a) 4, 7, 28 square units; 4 × 7 = 28 or 7 × 4 = 28* *b) 5, 6, 30 square units; 5 × 6 = 30 or 6 × 5 = 30*	3.MD.7b	**6 pts.** (3 pts. per problem): • 1 pt. for labeling the rectangle with the correct dimensions • 1 pt. for the correct area • 1 pt. for an accurate multiplication equation	
10 Demonstrates an understanding of area by marking the statements about it that are true. *Statements 2, 3, and 4 are true.*	3.MD.5a 3.MD.7a	**1 pt.**	
		Subtotal page 2	
		Subtotal from page 1	
Total Score/Level of Proficiency*		**40 pts.**	

* **Meeting Standard** 30–40 points (75%–100% correct) **Approaching Standard** 20–29 points (50–74% correct) **Strategic** 10–19 points (25–49% correct) **Intensive** 9 points or less (24% or less correct)

Unit 5 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a–d Identifies and solves the equation that best matches each of 4 different multiplication and division story problems. *a) 9 × 5 = 45 b) 40 ÷ 8 = 5* *c) 8 × 5 = 40 d) 45 ÷ 5 = 9*	3.OA.3 3.OA.7	**8 pts.** (2 pts. per problem): • 1 pt. for choosing the correct equation • 1 pt. for solving the equation correctly	
2a–b Solves a multiplication and a division equation. Writes a story problem to match each equation. *a) 36; students' story problems will vary. Example: I had 9 boxes. I put 4 books in each box. How many books in all?* *b) 7; students' story problems will vary. Example: TJ has 21 football cards. He put them into 3 equal rows on his wall. How many cards in each row?*	3.OA.1 3.OA.2 3.OA.7	**4 pts.** (2 pts. per problem) • 1 pt. for the correct answer • 1 pt. for a story problem that matches	
3 Writes a fact family of 2 multiplication and 2 division equations to describe a 4-by-7 array. *4 × 7 = 28 7 × 4 = 28* *28 ÷ 4 = 7 28 ÷ 7 = 4*	3.OA.1 3.OA.2	**4 pts.** • 1 pt. for each correct equation	
4a Solves a division story problem using numbers, labeled sketches, or words to show thinking. Writes an equation to match. *6 stacks; work will vary. Acceptable equations include: 60 ÷ 10 = 6; 60 – 10 – 10 – 10 – 10 – 10 – 10 = 0; 6 × 10 = 60; 10 × 6 = 60; 10 + 10 + 10 + 10 + 10 + 10 = 60.*	3.OA.3 3.OA.7	**3 pts.** • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer • 1 pt. for an equation that accurately represents the situation (does not have to be a division equation)	
4b Solves a multiplication story problem using numbers, labeled sketches, or words to show thinking. Writes an equation to match. *35 board games; work will vary.* *Acceptable equations include: 7 × 5 = 35; 5 × 7 = 35; 5 + 5 + 5 + 5 + 5 + 5 + 5 = 35; 7 + 7 + 7 + 7 + 7 = 35.*	3.OA.3 3.OA.7	**3 pts.** • 1 pt. for showing work and using a strategy that could lead to the correct answer • 1 pt. for the correct answer • 1 pt. for an equation that accurately represents the situation (does not have to be a multiplication equation)	
		Subtotal page 1	

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 6: Geometry
Pacing	4 weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

3.MD.5a Demonstrate understanding that a square with a side length of 1 unit is called a "unit square," has 1 square unit of area, and can be used to measure the areas of other plane figures.

3.MD.5b Demonstrate understanding that a plane figure that can be covered without gaps or overlaps by n unit squares has an area of n square units.
3.MD.7a Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.
3.MD.7b Find the area of a rectangle by multiplying its side lengths; represent the product of two numbers as they are of a rectangle with side lengths equal to those two numbers.
3.MD.7d Find the area of a figure that can be decomposed into non-overlapping rectangles and solve related story problems.
3.MD.8 Find the perimeter of a polygon, given its side lengths.
3.MD.8 Create rectangles with the same perimeter but different areas, as well as rectangles with the same area but different perimeters, and solve related story problems.
3.G.1 Identify rhombuses, rectangles, and squares as quadrilaterals.
3.G.1 Identify shared attributes of shapes in different categories.
3.G.1 Group shapes in different categories according to shared attributes that define a broader category.
3.G.2 Partition shapes into parts with equal areas; express the area of each equal part of a whole as a unit fraction of the whole.

Supporting Standards:

3.0A.3 Solve division story problems with dividends to 100 involving situations of equal groups.
3.NF.1 Demonstrate an understanding of a unit fraction 1/b as 1 of b equal parts into which a whole has been partitioned.
3.NF.3b Explain why two fractions must be equivalent.
3.NF.3b Generate simple equivalent fractions.
3.NF.3d Compare two fractions with the same numerator.
3.NF.3d Use the symbols >, =, and < to record comparisons of two fractions.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*

1. Find the area of a rectangle by multiplying the length of its sides.
2. Solve story problems involving finding the area of a rectangle.
3. Solve story problems that call for finding the area of a figure that can be decomposed into non-overlapping rectangles.
4. Find the perimeter of a polygon, given its side lengths.
5. Find an unknown side length of a polygon, given its perimeter and other side lengths
6. Identify rhombuses, rectangles, and squares as quadrilaterals.
7. Identify shared attributes of shapes in different categories (e.g., rhombuses and rectangles have 4 sides).
8. Partition shapes into parts with equal areas.

1. Area of a rectangle can be found by multiplying the length of its side by the width.
2. Story problem structures for multiplication and division.
3. Area is additive; you can find the area of a non-quadrilateral shape by decomposing the shape into smaller, rectangular areas and adding the areas together.
4. Perimeter of a polygon is found by adding the length of its sides.
5. In an addition equation, you can solve for an unknown addend by using a related subtraction equation.
6. There are special quadrilaterals that are classified by the length of their sides, measure of their angles, and number of sets of opposite parallel sides.
7. Special quadrilaterals share some attributes with other special quadrilaterals.
8. Shapes can be partitioned into different numbers of equal parts in different ways.
9. A fraction $1/b$ is the quantity formed by 1 part when a whole is partitioned into b equal parts. A fraction with a numerator of 1 is a unit fraction.

9. Express the area of each equal part of a whole as a unit fraction of the whole.	10. Quadrilaterals are 4-sided polygons. Not all quadrilaterals can be classified as a special quadrilateral- square, rectangle, etc.
10. Construct quadrilaterals that are not rhombuses, rectangles, or squares.	11. Shapes are classified by their attributes; shapes can be grouped by shared attributes.
11. Group shapes in different categories according to shared attributes that define a broader category.	12. A plane figure can be covered without any gaps or overlaps with *n* unit squares has an area of *n* square units.
12. Measure the area of a plane figure by counting the number of square units that cover it, with no gaps or overlaps.	13. The formula for calculating the area of a rectangle is length times width.
13. Find an area of a rectangle by multiplying the length of its sides.	14. Rectangles with different length sides can have the same areas, but different perimeters, or the same perimeters, but different areas.
14. Create rectangles with the same perimeter but different areas. Create rectangles with the same area but different perimeters.	

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why is it important to know the different attributes of geometric shapes?	1. Shapes are classified and categorized by their defining attributes, such as number of sides or types of angles and are described and sorted by their non-defining attributes,

2. Does a part (fraction) of a shape must be the same size shape in order to be equal to another part (fraction)?	such as size and color. 2. Fractional parts are equivalent if they represent the same part of the same-sized whole regardless of the way they are partitioned; a square is cut in halves if it is partitioned diagonally or horizontally/vertically even if the halves don't look the same.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

1.3.d Knowledge Constructor
Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

Informational Texts:

- **Informational Books:**
  - Grandfather Tang's Story
  - If You Were a Quadrilateral
  - The Warlords's Puzzle
  - Three Pigs, One Wolf and Seven Magic Shapes
  - The Greedy Triangle
  - Sir Cumference and the Isle of Immeter
  - MLC #FoundItOnAmazon bookshelf

- **Media:**
  - Math Learning Center Geometry Pinterest Board
  - Quad Song
  - Know Your Quadrilaterals Song
  - Shape Explorer- teacher tool

Online Resources / Websites:

- **MLC Apps:**
  - Geoboard App
  - Fractions App
- **Games:**
  - Concentration
  - Polygon Playground
  - Tangram Puzzles
  - Quadrilaterals Shapes Shoot
  - Zoo Designer

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Acute angle: an angle with a measure greater than 0 degrees and less than 90 degrees.
Angle: the figure formed by 2 rays or line segments that share an endpoint; often measured in terms of the amount of rotation (expressed as some number of degrees) needed to superimpose one of those rays or line segments onto the other.
Area: the total number of square units needed to cover a two-dimensional surface.
Array: an arrangement consisting of equal rows and equal columns.
Centimeter (cm): a metric unit of length equal to 1/100 of a meter or about ⅖ of an inch.
Congruent: of the same shape *and* size; two shapes are congruent if one can be exactly superimposed onto the other using a sequence of rotations, reflections, and/or translations.
Denominator: the bottom number in a fraction, which shows into how many equal parts the whole is divided; also, the divisor.
Dimension: the length, width, or height of a figure.
Divide: to break or split into equal parts; to determine how many times one number goes into another.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Equilateral: a figure having all its sides equal.
Equivalent fractions: two or more different fractions that represent the same quantity.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.

Foot (ft.): a customary unit of length equal to 12 inches.
Fraction: a number expressed as some number of equal parts of a whole.
Half: one part when a number, shape, or set is divided into exactly two equal parts.
Hexagon: a two-dimensional (flat) shape with 6 sides.
Line of symmetry: a real or imaginary line that divides a shape into two mirror images.
Meter (m): a metric unit of length equal to100 centimeters or about 39 inches.
Multiply: to find the product of two or more factors.
Numerator: the top number in a fraction, which shows how many equal parts are to be counted; also, the dividend.
Obtuse angle: an angle with a measure greater than 90 degrees and less than 180 degrees.
Parallel: always the same distance apart.
Parallelogram: a two-dimensional (flat) shape with 4 sides, with both pairs of opposite sides parallel.
Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement.
Pentagon: a two-dimensional (flat) shape with 5 sides.
Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference.
Perpendicular: intersecting at right angles.
Polygon: a closed two-dimensional (flat) shape with 3 or more sides.
Quadrilateral: a two-dimensional (flat) shape with 4 sides.
Rectangle: a two-dimensional (flat) shape with two pairs of parallel sides (4 sides total) and 4 right angles.
Rhombus: a two-dimensional (flat) shape with 4 congruent sides.
Right angle: an angle with a measure of exactly 90 degrees.
Rotation: a turn of a geometric figure.
Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles.
Symmetry: the property of a shape that can be folded so that the two halves match exactly.
Trapezoid: a two-dimensional (flat) shape with 4 sides, exactly 1 pair of which are parallel.
Vertex or Corner: the point at which the sides of a two-dimensional (flat) shape or the edges of a three-dimensional shape (solid) intersect.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

In Unit 6, students develop increasingly precise ways to describe, classify, and generalize about two-dimensional shapes, particularly quadrilaterals. In Week 1, students explore polygons in a variety of creative ways. In Week 2, they form polygons and special quadrilaterals to build understanding that shared attributes can define a larger category. Week 3 combines geometry and measurement as students measure the perimeters and areas of polygons. Week 4 offers students opportunities to apply what they've learned about quadrilaterals and areas in the context of fractions.

Week 1: Investigating Polygons
Students explore polygons while using a variety of tools and activities. The module begins with a pre-assessment. In Sessions 2 and 3, students use examples and nonexamples to explore the attributes of quadrilaterals. In Session 4, the class makes their own sets of tangram pieces. Since 5 of the 7 pieces (tans) are right triangles, a discussion of congruence and similarity naturally arises. In Work Place 6A Tangram Polygons, students use their tangram pieces to begin solving a series of geometric puzzles.

Lesson One: Unit 6 Pre-Assessment
Students spend the first part of this session taking the Unit 6 Pre-Assessment. Those who complete the assessment before the end of the period turn in their papers, get their Work Place folders, and choose a Work Place to do quietly while their classmates finish the assessment.

Lesson Two: Attributes of a Rectangle
Students examine examples and nonexamples of rectangles and share observations about the attributes of a rectangle to determine what distinguishes them from other quadrilaterals. Then they go to Work Places.

Lesson Three: Creating Shape Posters
Students work in pairs to create posters about the attributes of special quadrilaterals—squares, rhombuses, trapezoids, and parallelograms.

Lesson Four: Creating Tangrams
After students finish and share the shape posters they started last session, the teacher guides the class in following step-by-step instructions as they create their own sets of tangrams. Observations, examples, and definitions of geometric terminology arise throughout the process. When all the pieces have been cut, students identify the congruent and similar triangles in their collections.

Lesson Five: Constructing Polygons with Tangrams
After students reflect on their unit pre-assessments, the teacher guides them to review the names and definitions of the shapes they have investigated so far. Then they use various combinations of two tangram pieces they made in the previous session to construct a

square, a rectangle, a triangle, two trapezoids, and a parallelogram. Finally, the teacher introduces Work Place 6A Tangram Polygons.

Work Place 6A Tangram Polygons
Students choose the number of tangram pieces they want to use and then build the six polygons shown on the record sheet using just that number of pieces. As they build each polygon, they sketch and label the pieces to record their solution. In later sessions they can solve the same puzzle using a different number of tangram pieces.

Week 2: Quadrilaterals
Students continue to strengthen their understanding of polygons. In lesson 1, they build a variety of polygons out of toothpicks. After building squares, rectangles, and a variety of rhombuses, students work up to multi-sided polygons having as many as 12 sides (dodecagons). In Work Place 6B Geoboard Polygons, introduced in lesson 2, students create polygons to match clues given in the form of geometric attributes. In lessons 3, 4, and 5, they sort quadrilaterals and write quadrilateral riddles. Lesson 6, in which students estimate and measure the perimeters of 5 different quadrilaterals, transitions them into the next module, dealing with perimeter and area in greater depth.

Lesson Six: Making Toothpick Polygons
The teacher challenges students to make a series of polygons out of toothpicks. They build and explore the attributes of a progression of polygons: rectangles and rhombuses, pentagons, hexagons, and heptagons through dodecagons.

Lesson Seven: Introducing Geoboard Polygons
The teacher introduces Work Place 6B Geoboard Polygons, and students spend the rest of the session at Work Places.

Work Place 6B Geoboard Polygons
Students read descriptions of shapes and build examples on the geoboard of polygons with those attributes. They may make more than one of each polygon and then draw their favorite example for each on the record sheet.

Lesson Eight: Sorting Quadrilaterals
After reviewing the attributes of quadrilaterals and special quadrilaterals, each student builds four different quadrilaterals on a geoboard, draws and labels them on special recording paper, and cuts them out. Working together in small groups, students see how many ways they can find to sort their collection of quadrilaterals.

Lesson Nine: Guess My Quadrilateral

After a brief geometry checkpoint, students make their own sets of paper quadrilaterals. When everyone is ready, the teacher holds up an envelope containing one mystery quadrilateral from the set. She gives one clue at a time, from general to specific, until all but the quadrilateral that matches the one in the envelope have been eliminated.

Lesson Ten: Writing Quadrilateral Riddles

After the teacher models writing clues for a quadrilateral riddle, students select a shape from their set of cards and write a riddle for that shape. After testing their riddles, students write final drafts in riddle books to be used in an upcoming Work Place.

Lesson Eleven: Perimeters of Paper Quadrilaterals

After the teacher introduces the term perimeter and discusses it with the class, students estimate, measure, and compare the perimeters of five different paper quadrilaterals.

Week 3: Perimeter & Area

Students investigate perimeter and area as related but different ways to measure polygons. Module 3 opens with a story about a little raccoon who invites 328 neighbors to lunch and must prepare seating arrangements. The story provides a context for students to design and model tables by pushing square-inch tiles together to form rectangles. Over several sessions, students discover it's possible to build several different rectangles with a perimeter of 20 linear units, but each with a different area. Similarly, they find that it's possible to build several different rectangles with an area of 24 square units, but each with a different perimeter. These discoveries and others make for engaging learning opportunities.

Lesson Twelve: The 329th Friend: How Many Tables? Part 1

The teacher begins by reading the 329th Friend, in which a lonely little raccoon invites 328 neighbors to lunch. Then, students use tiles and linear units to model different table arrangements and determine the number that could be seated around each. Next, they design a variety of tables that will seat 10. Finally, they work in pairs to determine how many tables Emery Raccoon will need to seat 328 friends and himself if each table accommodates 10.

Lesson Thirteen: The 329th Friend: How Many Tables? Part 2

Students work in pairs to build rectangular tables that will seat exactly 20, and volunteers share their arrays at the board. Students discuss the arrays, noting that they all have a perimeter of 20 linear units but each is composed of a different number of tiles. The teacher works with input from the class to record a chart listing the dimensions, perimeter, and area of each array. Then the teacher introduces Work Place 6C Guess My Quadrilateral.

Work Place 6C Guess My Quadrilateral

Students solve at least 5 quadrilateral riddles written by their classmates. To start, they lay out one set of Quadrilateral Cards and use the clues to eliminate some of the cards until there's only one left. They write the answer to each riddle on a record sheet, tell which of the riddles was easiest to solve and which was most challenging, and give advice on how to improve one of the riddles.

Lesson Fourteen: Metric Rectangles
After discussing the difference between perimeter and area, students visually estimate the area of six printed rectangles. They cover each rectangle with base ten area pieces and record its area, along with an equation to show how they found the total. As they proceed and discuss their strategies, they work toward increasingly efficient methods, including the use of the area formula.

Lesson Fifteen: Bayard's Borrowed Tables
Today's session opens with a brief review of the fact that it's possible to create rectangles with the same perimeter but different areas. The teacher then challenges students to predict and then find out if it's possible to create rectangles with the same area but different perimeters.

Lesson Sixteen: Area and Perimeter Problems
Today's session opens with an area problem, which students solve and then discuss. The teacher introduces Work Place 6D Area or Perimeter and sends students to Work Places.

Work Place 6D Area or Perimeter
Student partners roll two 1–6 dice and choose to use the product of the numbers rolled as either an area or a perimeter. If they are working with an area, they build with tiles as many different rectangles as they can having that area and record the dimensions, area, and perimeter of each rectangle. If they are working with perimeter, they use red linear units to form as many rectangles as they can having that perimeter, and then record the dimensions, area, and perimeter of each.

Week 4: Shapes & Fractions
Shapes and area come together in the context of fractions as students find many ways to divide the largest square on the geoboard into congruent and noncongruent halves, determine the fractional value of different regions on the geoboard when the largest square is assigned an area of 1 square unit, and design their own geoboard quilt blocks. The module concludes with the Unit 6 Post-Assessment.

Lesson Seventeen: Exploring Halves on a Geoboard
Today's session opens with an area problem, which students solve and then discuss. The teacher introduces Work Place 6D Area or Perimeter and sends students to Work Places. Work Place 6D Area or Perimeter Student partners roll two 1–6 dice and choose to use the product of the numbers rolled as either an area or a perimeter. If they are working with an area, they build with tiles as many

different rectangles as they can having that area and record the dimensions, area, and perimeter of each rectangle. If they are working with perimeter, they use red linear units to form as many rectangles as they can having that perimeter, and then record the dimensions, area, and perimeter of each.

Lesson Eighteen: Fractions on a Geoboard
Building on the work they did in the previous session; students explore fractional relationships using the geoboard to represent 1 square unit. After participating in a class discussion, students complete a related assignment in their books. Students who finish before the end of the session visit Work Places.

Lesson Nineteen: Geoboard Quilt Blocks
Using their understanding of shapes, area, and fractions, students copy and then design their own geoboard quilt blocks. The largest square on the geoboard is again assigned an area of 1 square unit, and students determine what fraction of the geoboard is covered by each quilt block design.

Lesson Twenty: Unit 6 Post-Assessment
Students take the Unit 6 Post-Assessment and then go to Work Places.

Interdisciplinary / Real World / Global Connections

- The story of the raccoons and their lunch party provides a context for students to design and model tables by pushing square-inch tiles together to form rectangles. This context gives students a familiar situation to model and act out how different table arrangements (measurements) offer different numbers of seating (perimeters) for guests.
- The use of tangrams throughout this unit allows students many opportunities to create pictures that are made up of smaller geometric figures. This lays the groundwork for seeing shapes and geometric principles in the world around us- art, architecture, and designs.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☐ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☒ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- As you've been reading tangram story books to the class, you may have some students who would like to combine writing and math by making small sets of tangrams from scrap construction paper and then creating stories illustrated by their own tangram pictures.
- Ask students to determine how many tables it would take to seat all 329 friends if each table seats 20. Then ask them to advise Emery Raccoon as to whether to seat his friends in tables of 20 or tables of 10. Which arrangement results in fewer leftover seats at the last table? Why? Students may begin to see that if 329 friends are seated in groups of 10, there is just 1 seat left open at the last table. If they are seated at tables of 20, there are 11 empty seats at the last table—more than half of the last table is left empty. This can be an on-going challenge problem.

Support:

- Suggest specific work places for students who need to revisit previously learned skills.
- Provide students with index cards as tangible access to right angles. Encourage them to use the cards to compare the 90-degree angles to angles of shapes in their classwork.
- Allow access to Word Resource cards and/or the vocabulary app.
- Students should work with visual representations of mathematical ideas.
- If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulatives first.
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution.

- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

MLL (Multilingual Learners)**:**

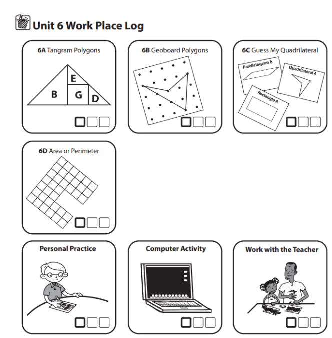
- Have students create personal visual dictionaries highlighting the meaning of important vocabulary words and supporting the language with picture examples of each term. Allow students access to this support on all assignments.
- Encourage students to draw and label models of the geometric concepts instead of explaining their ideas in writing or orally.
- Allow access to Word Resource cards and/or the vocabulary app.
- Pair MLL students with native English-speaking peers in order to provide opportunity for modeled language and for MLL students' practice speaking with the new vocabulary.
- Provide students with work place sentence frames written out on sentence strips. Keep the sentence strips in a bin or folder with work place materials so they are easily accessible.
- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 6 Pre-Assessment
- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 6 Polygons and Quadrilaterals Checkpoint
- Unit 6 Post-Assessment

Unit 6 Post-Assessment Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Finds the perimeter and area of a rectangle, given the dimensions. Writes an equation to represent work for each. Labels answers with the correct units. *P = 30 feet; A = 56 sq. feet; equations will vary.*	3.MD.7b 3.MD.8	**6 pts.** (3 pts. per measurement): • 1 pt. for the correct answer • 1 pt. for a viable equation • 1 pt. for labeling answer with correct units	
2 Chooses the correct equation for finding the area of a floor that is 4 feet wide and 6 feet long. *Choice 1: 4 × 6 = A.*	3.MD.7b	**1 pt.**	
3 Finds an unknown side length of a polygon, given its perimeter and other side lengths. Writes one or more equations to show how answer was obtained. *s = 3 meters. Equations will vary.*	3.MD.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable equation(s)	
4 Solves story problem that involves finding the area and perimeter of a square, given one of the side lengths. Shows work. Labels answers with correct units. *P = 32 feet, A = 64 square feet; work will vary.*	3.MD.7b 3.MD.8 3.MP.1	**6 pts.** (3 pts. per measurement): • 1 pt. for the correct answer • 1 pt. for viable work • 1 pt. for labeling answer with correct units	
5 Solves a story problem that involves finding the area of a figure that can be decomposed into non-overlapping rectangles. *150 sq. ft; work will vary.*	3.MD.7d	**2 pts.** • 1 pt. for the correct answer • 1 pt. for viable work that could lead to the correct answer	
6a–e Identifies different types of quadrilaterals. *a) Figs. 13, 15 green* *b) Figs. 7, 12 purple* *c) Figs. 1, 9 yellow* *d) Figs. 6, 8, 14 red* *e) Figs. 1, 2, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15 underlined*	3.G.1	**5 pts.** • 1 pt. for every response that is entirely correct	
7 Identifies two quadrilaterals by name. Lists 3 similarities and 3 differences. *parallelogram, rectangle; students' lists of similarities and differences will vary. See answer key for examples.*	3.G.1	**8 pts.** • 1 pt. per quadrilateral identified by name • 1 pt. for each similarity or difference that is accurate and includes at least one word from the Word Bank used correctly in context	
8 Partitions shapes into parts with equal areas. Expresses the area of each part as a unit fraction of the whole. *¼; drawings will vary.*	3.G.1	**2 pts.** • 1 pt. for each accurate drawing labeled with ¼ (parts do not have to be congruent, just equal in area)	
Total Score/Level of Proficiency*		**32 pts.**	

* **Meeting Standard** 24–32 points (75%–100% correct) **Approaching Standard** 16–23 points (50–74% correct) **Strategic** 8–15 points (25–49% correct) **Intensive** 7 points or less (24% or less correct)

Polygons & Quadrilaterals Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Identifies quadrilaterals, including parallelograms, rectangles, rhombuses, and trapezoids. *Figures B, D, E, and G should be circled; Figures A, C, F, and H should not be circled.*	3.G.1	**4 pts.** • ½ pt. for each shape correctly identified as either a quadrilateral or a nonquadrilateral	
2 Uses words or labeled sketches to tell or show one way in which parallelograms are like rhombuses & rectangles. *Responses will vary. See answer key for examples.*	3.G.1	**1 pt.**	
3 Identifies and circles the polygons. *Figures A and D should be circled; Figures B and C should not be circled.*	3.G.1	**2 pts.** • ½ pt. for each shape correctly identified as either a polygon or a nonpolygon	
4 Identifies a figure as a nonpolygon and gives at least 2 reasons why it is not a polygon. *Yes (Damon is correct). Explanations will vary. Example: It is not a polygon because it is not closed, and one of its sides is curved instead of straight.*	3.G.1	**3 pts.** • 1 pt. for correctly identifying the figure as a nonpolygon • 1 pt. for each valid reason	
5 Compares and contrasts a square and a rhombus by explaining one way in which the two shapes are alike and one way in which they are different. *Responses will vary. See answer key for examples.*	3.G.1	**2 pts.** • 1 pt. for a valid likeness • 1 pt. for a valid difference	
6 Draws a parallelogram on a geoboard. *Drawings will vary, and may be any parallelogram, including a square, a rectangle, a rhombus, or a parallelogram.*	3.G.1	**1 pt.**	
7 Identifies names that can be used to label both a parallelogram and a rectangle. *Choices 1 and 4, quadrilaterals and parallelograms.*	3.G.1	**2 pts.** • ½ pt. for each bubble correctly filled or left blank	
Total Score/Level of Proficiency*		**15 pts.**	

* **Meeting Standard** 12–15 points (75%–100% correct) **Approaching Standard** 8–11 points (50–74% correct) **Strategic** 4–7 points (25–49% correct) **Intensive** 3 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 7: Extending Multiplication and Fractions
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
3.OA.1 Interpret products of whole numbers.
3.OA.5 Multiply using the commutative, associative, and distributive properties.
3.OA.7 Fluently multiply with products to 100 using strategies.

3.0A.8 Solve two-step story problems using addition, subtraction, multiplication, and division.
3.OA.8 Write equations with a letter standing for the unknown quantity to represent two-step story problems.
3.OA.8 Assess the reasonableness of answers to story problems using mental computation, rounding, and other estimation strategies.
3.NBT.3 Multiply whole numbers from 1 to 9 by multiples of 10 from 10 to 90 using strategies based on place value and properties of operations.
3.NF.1 Demonstrate an understanding of a unit fraction 1/*b* as 1 of *b* equal parts into which a whole has been partitioned, and fraction *a/b* as a equal parts, each of which is 1/*b* of a whole.
3.NF.2 Locate fractions on a number line; place them in their correct positions on a number line.
3.NF.2a Show a unit fraction 1/*b* on a number line by defining the interval from 0 to 1 as the whole and then partitioning it into *b* equal parts.
3.NF.2a Show that the interval from 0 to 1 on the number line is partitioned into *b* equal parts, each part is 1/*b* of the whole.
3.NF.2a Locate 1/*b* on the number line after partitioning the interval from 0 to 1 into *b* equal parts.
3.NF.2b Show a fraction *a/b* on a number line by marking off, starting at 0, a length of 1/*b* each and labeling the resulting interval *a/b*.
3.NF.3a Identify equivalent fractions by comparing their sizes or their locations on a number line.
3.NF. 3b Recognize and generate simple equivalent fractions; explain why two fractions must be equivalent.
3.NF.3c Write a whole number as a fraction; Recognize fractions that are equivalent to whole numbers.
3.NF.3d Compare two fractions with the same numerator or denominator; use the symbols >, =, and < to record comparisons; explain why one fraction must be greater than or less than another fraction.

Supporting Standards:
3.MD.7b Find the area of a rectangle by multiplying its side lengths; represent the product of two numbers as the area of a rectangle with side lengths equal to those two numbers.
3.MD.7c Use the area model for multiplication to illustrate the distributive property.
3.G.2 Express the area of each equal part of a whole as a unit fraction of the whole.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*

1. Interpret products of whole numbers.	1. A product is the answer to a multiplication problem and is found by multiplying two factors.
2. Multiply using the commutative, associative, and distributive properties.	2. There are 4 properties of multiplication that provide rules for quickly solving multiplication problems according to properties that always apply to certain equations.
3. Fluently multiply with products to 100 using strategies.	3. It is important to know all one-digit by one-digit multiplication facts with automaticity, or by using an efficient strategy.
4. Solve two-step story problems using addition, subtraction, multiplication, and division.	4. Problem structures for all four operations are predictable and by applying knowledge of these structures we can solve word problems involving one or two steps.
5. Write equations with a letter standing for the unknown quantity to represent two-step story problems.	5. AN equation can have a letter in any position to represent the value that is unknown.
6. Assess the reasonableness of answers to story problems using mental computation, rounding, and other estimation strategies.	6. By estimating an answer to a problem we can determine if our calculations make sense.
7. Multiply whole numbers from 1 to 9 by multiples of 10 from 10 to 90 using strategies based on place value and properties of operations.	7. Every place in our number system is ten times the place to its right.
8. Demonstrate an understanding of a unit fraction 1/b as 1 of b equal parts into which a whole has been partitioned, and of a fraction a/b as a equal parts, each of which is 1/b of a whole.	8. A fraction 1/*b* is the quantity formed by 1 part when a whole is partitioned into *b* equal parts. A fraction with a numerator of 1 is a unit fraction.
9. Place fractions in their correct positions on a number line.	

	9. By partitioning a number line between two whole numbers we can locate a fraction’s position.
10. Show a unit fraction 1/b on a number line by defining the interval from 0 to 1 as the whole and then partitioning it into b equal parts.	10. A unit fraction has a numerator of 1.
11. Show that if the interval from 0 to 1 on the number line is partitioned into b equal parts, each part is 1/b of the whole.	11. The denominator of a fraction tells us how many intervals there are between any two whole numbers on a number line.
12. Locate 1/b on the number line after partitioning the interval from 0 to 1 into b equal parts.	12. Beginning at 0 we can count hops on the number line to determine the location of a fraction based on its numerator.
13. Show a fraction a/b on a number line by marking off, starting at 0, a length of 1/b each and labeling the resulting interval a/b.	13. Fractions can be partitioned and labeled on number lines in the same way we mark and label whole numbers.
14. Identify equivalent fractions by comparing their sizes or their locations on a number line.	14. A single point on the number line can be represented with more than one number.
15. Recognize and generate simple equivalent fractions and explain why they must be equivalent.	15. Fractions that represent the same part of a whole and point on a number line are equivalent.
16. Write a whole number as a fraction; Recognize fractions that are equivalent to whole numbers.	16. Whole numbers can be written as fractions with a denominator of 1.
17. Compare two fractions with the same numerator or denominator; use the symbols >, =, and < to record comparisons; explain why one fraction must be greater than or less than another fraction.	17. The larger the number in the denominator of a fraction, the smaller the unit fraction.
18. Find the area of a rectangle by multiplying its side lengths; represent the product of two numbers as the area	

of a rectangle with side lengths equal to those two numbers. 19. Use the area model for multiplication to illustrate the distributive property.	18. Area is the measurement of the space inside of a shape. Area of a rectangle can be found by multiplying the length by the width. 19. Area is additive. The dimensions of a rectangular array can be decomposed into smaller parts in order to make multiplication easier.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How are fractions like/different from whole numbers?	1. Fractions are numbers. Fractions operate and quantify like whole numbers. We can place fractions on the number line, compose and decompose fractions and order and compare fractions.
2. How can we use multiplication to find area?	2. The area model is a progression from the array. A rectangular area can be built with equal rows or columns. The area can be calculated by multiplying the number of rows by the number of columns. The area model is the foundation for understanding the distributive property.

Resources
Student Technology Integration and [Correspondence to ISTE Standards](#) when Applicable: **1.3.d Knowledge Constructor:** Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions. **1.6.a Creative Communicator:** Students choose the appropriate platforms and tools for meeting the desired objectives of their

creation or communication.

Informational Texts:

- **Informational Books:**
  - MLC #FoundItOnAmazon Division Bookshelf
  - MLC #FoundItOnAmazon Fractions and Decimals Bookshelf
  - Ten Times Better
  - The Best of Times
- **Media:**
  - Math Tappers Multiples app
  - MLC Multiplication and Division Pinterest board
  - Arrays, Multiplication and Division teacher reference

Online Resources / Websites:

- **MLC Apps:**
  - Number Pieces
  - Fractions
- **Games:**
  - Meteor Multiplication
  - Multiplication Grand Prix
  - Bunny Times
  - Concentration
  - Pecking Order

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Array: an arrangement consisting of equal rows and equal columns.
Associative Property of Multiplication: the property by which the product remains unchanged no matter how the numbers being multiplied are grouped, so that *(a x b) x c =a x (b x c)*.
Data: items of information; may include facts, numbers, or measurements.

Denominator: the bottom number in a fraction, which shows into how many equal parts the whole is divided; also, the divisor.
Dimension: the length, width, or height of a figure.
Divide: to break or split into equal parts; to determine how many times one number goes into another.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Fraction: a number expressed as some number of equal parts of a whole.
Equivalent Fractions: two or more different fractions that represent the same quantity.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs.
Factor: a whole number that divides evenly into another number.
Foot (ft.): a customary unit of length equal to 12 inches.
Fraction: a number expressed as some number of equal parts of *a.*
Half: one part when a number, shape, or set is divided into exactly two equal parts.
Impossible: will not occur.
Likely: has more than a 50% chance of occurring.
Line plot: a horizontal number line that uses markings (such as an X or a dot) to show data points above their values on the line.
Mode: the value (or values) that appear most often in a set of data; there may be no mode, one mode, or multiple modes in a single set of data.
Multiple: a number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3.
Multiply: to find the product of.
Number line: a diagram in which numbers are represented as points on a line.
Numerator: the top number in a fraction, which shows how many equal parts are to be counted; also, the dividend.
Parentheses: curved marks used to group mathematical symbols.
Partition: to divide into portions or pieces.
Pattern: a collection of numbers, shapes, or objects that form a consistent or characteristic arrangement.
Probability: the likelihood that an event will occur, measured on a scale from 0 (impossible) to 1 (certain).
Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array.
Unit fraction: a fraction with a numerator of 1.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Unit 7 provides a review of material covered earlier in the year, as well as opportunities to extend skills and concepts into work with larger numbers and bigger ideas. Early in the unit, students learn to multiply single digits by multiples of 10. That skill is then extended into building and sketching 1-digit by 2-digit multiplication combinations. Working with multiplication beyond the basic facts provides rich opportunities to review the commutative and distributive properties and tap into the power of the associative property of multiplication. Having worked previously with fractions as parts of a whole and distances along a number line, students are introduced to linear and area models that allow them to see fractions as parts of a set as well as a parts of a whole. These models include a ruler, an egg carton, a 12-foot strip of adding machine tape, and a circle graph. The unit ends with a foray into data collection, representation, and interpretation, foreshadowing the work with measurement and data students will do in Unit 8.

Week 1: Multiplication Beyond the Basics
This is the first of two weeks designed to solidify students' understanding of multiplication and extend their thinking beyond the basic facts into 1-by-2-digit multiplication. After reviewing the use of equations to represent two-step story problems that involve multiplication, students explore strategies for multiplying single digits by 11, and then by 12. The last lesson this week serves as a bridge into the second week, as students investigate multiplication of single digits by multiples of ten.

Lesson One: Unit 7 Pre-Assessment
Students spend the first part of this session taking the Unit 7 Pre-Assessment. Those who complete the assessment before the end of the session turn in their papers, get their Work Place folders, and choose a Work Place to do quietly while their classmates finish the assessment.

Lesson Two: Multiplication Stories and Equations
Today, students solve two-step story problems that involve multiplication, as well as addition and subtraction. The class works two problems together, reviewing the use of equations to represent such problems. Students then work on their own or in pairs to complete a related assignment in their Student Books, and go to Work Places as they finish.

Lesson Three: Multiplying by Eleven
Today's session opens with a warm-up in which students read a two-step story problem, write equations to represent the problem, solve it, and then share their strategies. Then they explore various strategies for multiplying by 11 and complete a related assignment in their Student Books. Students who finish the assignment before the end of the session go to Work Places.

Lesson Four: Multiplying by Twelve
After reflecting on the unit pre-assessments from Session 1, students read another two-step story problem, write equations to represent the problem, solve it, and then share their strategies. Then they explore various strategies for multiplying by 12 and complete a related assignment in their Student Books.

Lesson Five: Multiplying Single Digits by Multiples of Ten
Today's session opens with a warm-up in which students read another two-step story problem, write equations to represent the problem, solve it, and then share their strategies. Then they make sketches to investigate and make generalizations about multiplying single digits by multiples of ten and complete a related assignment in their Student Books. Students who finish the assignment before the end of the session go to Work Places.

Week 2: One-by-Two-Digit Multiplication
Students continue their work with multiplication as they explore and discuss 1-by-2-digit arrays and add to their collection of multiplication strategies. Strings, activities, class discussions, and a poster project all help students develop facility with multiplying single digits by multiples of 10, partial products, the associative property, and the distributive property as they model and solve larger multiplication problems.

Lesson Six: Building Arrays for One-by-Two-Digit Multiplication Problems
This session begins with a problem string designed to help students make use of what they know about problems that involve multiplying by 10, and partial products. Then, students use base ten area and linear pieces to construct arrays for story problems that involve 1- and 2-digit factors. In this way, students create a model that allows them to see the partial products and strengthen their understanding of area and dimension in the process.

Lesson Seven: Sketching Arrays for One-by-Two-Digit Multiplication
After taking a brief checkpoint, students work in pairs to build an array with base ten linear and area pieces to model a 1-by-2-digit multiplication story problem. The teacher guides them in sketching their array. After student pairs solve the problem, they share their strategies with classmates. Then they model, sketch, and solve a second story problem.

Lesson Eight: Mystery Arrays
This session begins with a longer problem string designed to deepen students' understanding of partial products. After the string and a couple of warm-up exercises, the students work in pairs to create models for 1-by-2-digit multiplication combinations using only linear pieces. They find the product for their combination and tour the room to visit others' models. Based on the linear pieces

alone, they predict what the product of each model they visit will be and then find the exact answer.

Lesson Nine: Making Posters for One-by-Two Arrays
After exploring the similarities between the arrays for 4 × 3 and 4 × 30, the class decides what to include on a poster representing 4 × 33. Then student pairs construct posters for specific 1-by-2-digit multiplication combinations. Each poster includes a labeled array made from paper base ten area pieces and equations showing at least two ways to find the product. As they work on the posters, the teacher confers with students, providing support and challenge as needed.

Lesson Ten: Sharing Multiplication Posters
Students spend a few minutes finalizing and reviewing their array posters from Session 4. Then each pair meets with another pair to share and discuss their work. Next, the teacher reconvenes the class to investigate the use of the associative property to solve multiplication problems, including 1-by-2-digit combinations. Students spend any time remaining in the session at Work Places.

Week 3: Fractions as Parts of a Whole & Parts of a Set
Module 3 features a return to fractions, introducing three new ways to model, compare, and generate equivalent fractions—a 12-inch ruler, a 12-foot-long strip of adding machine tape, and tiles in an egg carton subdivided with one or more pieces of yarn. These models allow students to work with halves, thirds, fourths, sixths, and twelfths as they conduct a variety of investigations and learn to play a new fraction game.

Lesson Eleven: Fractions on a Ruler
This session begins with a problem string that revisits and extends work with the associative property of multiplication. The focus of instruction then shifts, as students work with a linear measurement model for fractions: their 12-inch rulers. Foot-long strips of paper are subdivided into fractional parts and compared based on length. These sections are then used to compare and order fractions.

Lesson Twelve: Introduction to Egg Carton Fractions
After students work together to fold a 12-foot length of adding machine tape in half, thirds, and then half again, creating 12 one-foot sections, the teacher introduces the egg carton as a model for representing fractions as parts of a whole and parts of a set. Students model a variety of unit fractions on the egg cartons and the folded paper strip, reviewing the meaning of the term's numerator and denominator in the process.

Lesson Thirteen: Exploring Egg Carton Fractions
Students continue their explorations with the egg carton fraction model as they investigate how many fractions, they can build with

the egg carton in addition to the unit fractions they made last session.

Lesson Fourteen: Equivalent Egg Carton Fractions
Today, students determine the fractions of a dozen represented by different numbers of eggs. In doing so, they explore the concept of equivalent fractions. The teacher uses the folded and labeled paper strip to reinforce students' discoveries, and to provide another way to look at equivalent fractions.

Lesson Fifteen: Dozens of Eggs
In this session, the teacher introduces a new Work Place game called Dozens of Eggs. This game uses the egg carton fraction model to further students' understanding of equivalent fractions and provide an informal introduction to the addition of fractions.

Work Place 7A Dozens of Eggs Players take turns drawing from the deck of fraction cards, modeling the designated fraction on an egg carton with colored tiles and yarn, and recording the results. Players take turns until one person has filled all four egg cartons on his or her record sheet and written a matching addition equation that equals 1 whole for each carton. The first player to fill all four egg cartons wins.

Week 4: Fractions at Work
Students have an opportunity to apply their understanding of fractions to contexts involving a new number line game, division, and data collection, representation, and analysis. The module ends with the Unit 7 Post-Assessment.

Lesson Sixteen: Racing Fractions
Today, students make their own game boards for a new Work Place, Racing Fractions. In the process, they locate and label fractions along a set of five number lines, each of which has been partitioned into a different number of equal parts. After preparing their game boards, students play a game of Racing Fractions with the teacher, and then again in pairs. If time still remains in the session, students go to Work Places. Work Place 7B Racing Fractions Players take turns drawing two Number Cards, arranging the cards to form a fraction, and moving game markers along the Racing Fractions Game Board. Each player has a game marker on each line of the game board and may move one or more markers in a single turn to equal the fraction formed. The first player to move her markers to 1 on all the number lines on her game board is the winner.

Lesson Seventeen: Pizza Fractions
This session opens with a brief checkpoint. Then students investigate the connection between fractions and division, working in pairs to determine how much pizza each person would get if various numbers of pizzas were shared equally among different numbers of people. The class shares what they discovered during their problem-solving investigations. If time remains at the end of

the session, students go to Work Places.

Lesson Eighteen: Surveys and Fractions
Students continue their work with twelfths today as they independently pose a survey question to 12 classmates, organize the results, and record the data on a circle graph. Then they interpret the data as fractional parts of a set of 12. At the end of the session, and in the days that follow, students share their circle graphs, and the class draws conclusions and inferences from them.

Lesson Nineteen: Pull and Graph
The teacher draws from a bag containing 8 green and 4 yellow tiles and records the data on a circle graph. Then each pair of students completes the same experiment. The class combines their results on a line plot to see what kinds of results were most common for 12 draws. After discussing the results, students spend the rest of the session at Work Places.

Lesson Twenty: Unit 7 Post-Assessment
Students take the Unit 7 Post-Assessment and then go to Work Places.

Interdisciplinary / Real World / Global Connections

- This unit introduces new contexts for fractions, the ruler and egg carton. These contexts give students a chance to make connections to real world applications of fractions; measurement and cooking/food. These will be developed further in their work in fourth grade.
- Students get experience with probability, data collection, and data analysis in the final week of this unit. As they present their data in a circle graph, their data analysis is connected to the part-whole model of fractions. Students can use technology to create graphs from their data set in the Fractions App or in Google Docs or Google Sheets.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

- ☒ Critically Problem Solving
- ☐ Effectively Communicating
- ☐ Creatively Thinking
- ☒ Persevering
- ☒ Socially Aware
- ☐ Responsibly Making Decisions

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play.
- See "Game Variations" in work place guides.
- See "Assessment and Differentiation" in work place teacher masters.

Support:

- Suggest specific work places for students who need to revisit previously learned skills.
- Allow access to Word Resource cards and/or the vocabulary app.
- Students should work with visual representations of mathematical ideas.
- If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulatives first.
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution.
- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

MLL (Multilingual Learners)**:**

- Have students create personal visual dictionaries highlighting the meaning of important vocabulary words and supporting the language with picture examples of each term. Allow students access to this support on all assignments.
- Allow access to Word Resource cards and/or the vocabulary app.

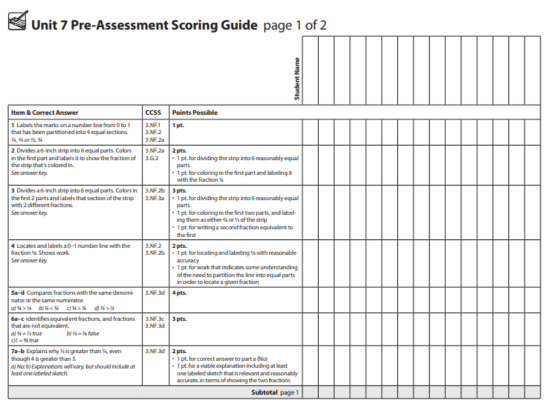
- Pair MLL students with native English-speaking peers in order to provide opportunity for modeled language and for MLL students' practice speaking with the new vocabulary.
- Provide students with work place sentence frames written out on sentence strips. Keep the sentence strips in a bin or folder with work place materials so they are easily accessible.
- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 7 Pre-Assessment
- Workplaces
- Home Connections
- Student Book Class Work



Unit 7 Pre-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Labels the marks on a number line from 0 to 1 that has been partitioned into 4 equal sections. *1/4, 2/4 or 1/2, 3/4*	3.NF.1 3.NF.2 3.NF.2a	**1 pt.**	
2 Divides a 6-inch strip into 6 equal parts. Colors in the first part and labels it to show the fraction of the strip that's colored in. *See answer key.*	3.NF.2a 3.G.2	**2 pts.** • 1 pt. for dividing the strip into 6 reasonably equal parts • 1 pt. for coloring in the first part and labeling it with the fraction 1/6	
3 Divides a 6-inch strip into 6 equal parts. Colors in the first 2 parts and labels that section of the strip with 2 different fractions. *See answer key.*	3.NF.2b 3.NF.3a	**3 pts.** • 1 pt. for dividing the strip into 6 reasonably equal parts • 1 pt. for coloring in the first two parts, and labeling them as either 2/6 or 1/3 of the strip • 1 pt. for writing a second fraction equivalent to the first	
4 Locates and labels a 0–1 number line with the fraction 5/6. Shows work. *See answer key.*	3.NF.2 3.NF.2b	**2 pts.** • 1 pt. for locating and labeling 5/6 with reasonable accuracy • 1 pt. for work that indicates some understanding of the need to partition the line into equal parts in order to locate a given fraction	
5a–d Compares fractions with the same denominator or the same numerator. *a) 3/4 > 1/4 b) 1/6 < 5/6 c) 3/4 > 3/6 d) 4/5 > 1/5*	3.NF.3d	**4 pts.**	
6a–c Identifies equivalent fractions, and fractions that are not equivalent. *a) 2/6 = 1/3 true b) 1/4 = 3/6 false c) 1 = 6/6 true*	3.NF.3c 3.NF.3d	**3 pts.**	
7a–b Explains why 1/3 is greater than 1/4, even though 4 is greater than 3. *a) No; b) Explanations will vary, but should include at least one labeled sketch.*	3.NF.3d	**2 pts.** • 1 pt. for correct answer to part a (No) • 1 pt. for a viable explanation including at least one labeled sketch that is relevant and reasonably accurate, in terms of showing the two fractions	
		Subtotal page 1	

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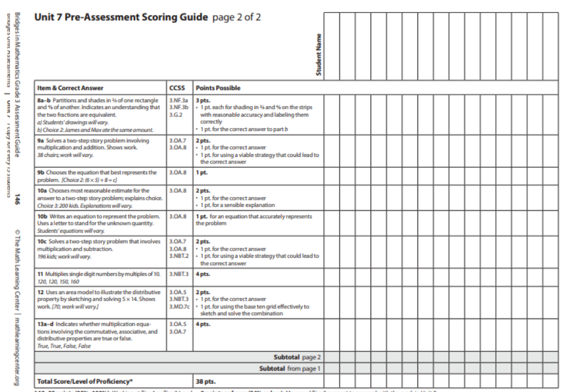

Unit 7 Pre-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
8a–b Partitions and shades in 3/4 of one rectangle and 6/8 of another. Indicates an understanding that the two fractions are equivalent. *a) Students' drawings will vary. b) Choice 2: James and Max ate the same amount.*	3.NF.3a 3.NF.3b 3.G.2	**3 pts.** • 1 pt. each for shading in 3/4 and 6/8 on the strips with reasonable accuracy and labeling them correctly • 1 pt. for the correct answer to part *b*	
9a Solves a two-step story problem involving multiplication and addition. Shows work. *38 chairs; work will vary.*	3.OA.7 3.OA.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using a viable strategy that could lead to the correct answer	
9b Chooses the equation that best represents the problem. *(Choice 2: (6 × 5) + 8 = c)*	3.OA.8	**1 pt.**	
10a Chooses most reasonable estimate for the answer to a two-step story problem; explains choice. *Choice 3: 200 kids. Explanations will vary.*	3.OA.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for a sensible explanation	
10b Writes an equation to represent the problem. Uses a letter to stand for the unknown quantity. *Students' equations will vary.*	3.OA.8	**1 pt.** for an equation that accurately represents the problem	
10c Solves a two-step story problem that involves multiplication and subtraction. *196 kids; work will vary.*	3.OA.7 3.OA.8 3.NBT.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using a viable strategy that could lead to the correct answer	
11 Multiplies single digit numbers by multiples of 10. *120, 120, 150, 160*	3.NBT.3	**4 pts.**	
12 Uses an area model to illustrate the distributive property by sketching and solving 5 × 14. Shows work. *(70; work will vary.)*	3.OA.5 3.NBT.3 3.MD.7c	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using the base ten grid effectively to sketch and solve the combination	
13a–d Indicates whether multiplication equations involving the commutative, associative, and distributive properties are true or false. *True, True, False, False*	3.OA.5 3.OA.7	**4 pts.**	
		Subtotal page 2	
		Subtotal from page 1	
Total Score/Level of Proficiency*		**38 pts.**	

* **10–38 points (25%–100%):** Working at Tier 1 or Tier 2 Level **9 points or fewer (24% or less):** May need Tier 3 support to succeed with the work in Unit 7

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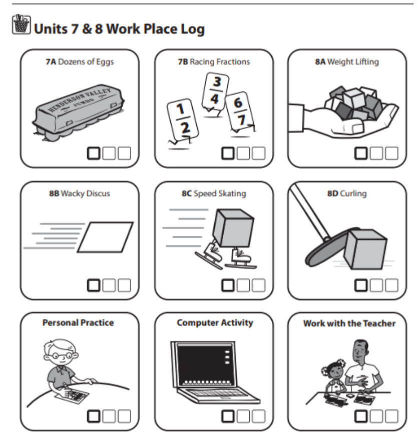


Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Multiplication and Division Checkpoint
- Fractions Checkpoint
- Unit 7 Post-Assessment

Fractions Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Demonstrates an understanding that $\frac{1}{4}$ is greater than $\frac{1}{8}$, even though 8 is greater than 4. *Note that students can present valid reasons to agree or disagree with Daniel's choice. Look for understanding and demonstration that $\frac{1}{4} > \frac{1}{8}$.*	3.NF.3d	**2 pts.** • 1 pt. for presenting valid reasons to agree or disagree with Daniel's choice • 1 pt. for using numbers and labeled sketches to show that $\frac{1}{4} > \frac{1}{8}$	
2 Labels the marks on a number line from 0 to 1 that has been partitioned into 6 equal sections. *$\frac{1}{6}$, $\frac{2}{6}$ or $\frac{1}{3}$, $\frac{3}{6}$ or $\frac{1}{2}$, $\frac{4}{6}$ or $\frac{2}{3}$, $\frac{5}{6}$*	3.NF.1 3.NF.2 3.NF.2a	**1 pt.**	
3 Writes 3 different fractions to describe the part of the egg carton that is filled by 6 eggs. Draws dividing lines to partition each egg carton to show the relevant fraction. *$\frac{1}{2}$, $\frac{2}{4}$, $\frac{3}{6}$ ($\frac{6}{12}$ is acceptable, but not expected)*	3.NF.3b 3.G.2	**3 pts.** • 1 pt. for each correct answer. (To be considered correct, the egg carton accompanying the fraction needs to be accurately subdivided. For example, divided into sixths to show $\frac{3}{6}$.)	
4 Locates and labels a 0–1 number line with the fraction $\frac{3}{8}$. Shows work. *Work will vary.*	3.NF.2 3.NF.2b	**2 pts.** • 1 pt. for locating and labeling $\frac{3}{8}$ with reasonable accuracy • 1 pt. for showing work that indicates some understanding of the need to partition the line into equal parts in order to locate a given fraction	
5a–d Compares fractions with the same denominator or the same numerator. *$\frac{1}{4} < \frac{1}{3}$, $\frac{4}{6} > \frac{3}{6}$, $\frac{2}{4} > \frac{2}{6}$, $\frac{4}{4} > \frac{3}{4}$*	3.NF.3d	**4 pts.**	
Total Score/Level of Proficiency*		**12 pts.**	

* **Meeting Standard** 9–12 points (75%–100% correct) **Approaching Standard** 6–8 points (50–74% correct) **Strategic** 3–5 points (25–49% correct) **Intensive** 2 points or less (24% or less correct)

Multiplication & Division Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Writes 2 multiplication and 2 division equations to describe a 3-by-5 array. *$3 \times 5 = 15$, $5 \times 3 = 15$, $15 \div 3 = 5$, $15 \div 5 = 3$*	3.OA.1 3.OA.2 3.MD.7a	**4 pts.** • 1 pt. for each correct equation (order doesn't matter)	
2 Labels an array with its dimensions, then finds its area. Shows work. *Dimensions: 8, 20; Area = 160 sq. units. Student equations will vary. Example: $8 \times 10 = 80$, and $80 + 80 = 160$.*	3.NBT.3 3.MD.7a 3.MD.7b	**3 pts.** • 1 pt. for the correct dimensions • 1 pt. for the correct area • 1 pt. for using a strategy that demonstrates understanding that the area of an array can be found by multiplying its side lengths	
3a Demonstrates an understanding of the distributive property of multiplication. *Yes; students' explanations will vary. Example: Because 18 is 10 + 8, and you can multiply each number and add the answers to get 4×18.*	3.OA.5	**2 pts.** • 1 pt. for the correct answer (yes) • 1 pt. for providing a reasonable explanation as to why Pablo's strategy works.	
3b Solves 4×18; shows work. *72; work will vary. Example: $4 \times 10 = 40$, $4 \times 8 = 32$, $40 + 32 = 72$.*	3.OA.5 3.MP.1	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using a viable strategy that could lead to the correct answer	
4a Solves a division story problem; shows work. *5 bags; work will vary. Example: $6 + 6 + 6 + 6 + 6 = 30$, so it will take 5 bags.*	3.OA.3	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using a viable strategy that could lead to the correct answer	
4b Writes an equation to represent a division story problem. *Students' equations will vary. Examples: $30 \div 6 = 5$; $30 \div 5 = 6$; $5 \times 6 = 30$; $6 \times 5 = 30$; $30 - 6 - 6 - 6 - 6 - 6 = 0$; $6 + 6 + 6 + 6 + 6 = 30$*	3.OA.3	**1 pt.**	
Total Score/Level of Proficiency*		**14 pts.**	

* **Meeting Standard** 11–14 points (75%–100% correct) **Approaching Standard** 7–10 points (50–74% correct) **Strategic** 4–6 points (25–49% correct) **Intensive** 3 points or less (24% or less correct)

Unit 7 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Labels the marks on a number line from 0 to 1 that has been partitioned into 8 equal sections. *$\frac{1}{8}$, $\frac{2}{8}$ or $\frac{1}{4}$, $\frac{3}{8}$, $\frac{4}{8}$ or $\frac{1}{2}$, $\frac{5}{8}$, $\frac{6}{8}$ or $\frac{3}{4}$, $\frac{7}{8}$; see answer key.*	3.NF.1 3.NF.2 3.NF.2a	**1 pt.**	
2 Divides a 6-inch strip into 6 equal parts. Colors in the first part and labels it to show the fraction of the strip that's colored in. *See answer key.*	3.NF.2a 3.G.2	**2 pts.** • 1 pt. for dividing the strip into 6 reasonably equal parts • 1 pt. for coloring in the first part and labeling it with the fraction $\frac{1}{6}$	
3 Divides a 6-inch strip into 6 equal parts. Colors in the first 4 parts and labels that section of the strip with 2 different fractions. *See answer key.*	3.NF.2b 3.NF.3a	**3 pts.** • 1 pt. for dividing the strip into 6 reasonably equal parts • 1 pt. for coloring in the first two parts, and labeling them as either $\frac{4}{6}$ or $\frac{2}{3}$ of the strip • 1 pt. for a second fraction equivalent to the first	
4 Locates and labels a 0–1 number line with the fraction $\frac{7}{8}$. Shows work. *Work will vary. See answer key.*	3.NF.2 3.NF.2b	**2 pts.** • 1 pt. for locating and labeling $\frac{7}{8}$ with reasonable accuracy • 1 pt. for work that shows some understanding of the need to partition the line into equal parts in order to locate a given fraction	
5a–d Compares fractions with the same denominator or the same numerator. *a) $\frac{5}{6} > \frac{3}{6}$ b) $\frac{3}{4} > \frac{3}{8}$ c) $\frac{2}{3} > \frac{2}{8}$ d) $\frac{4}{8} < \frac{4}{6}$*	3.NF.3d	**4 pts.**	
6a–c Identifies equivalent fractions, and fractions that are not equivalent. *a) $\frac{3}{6} = \frac{4}{8}$ true b) $\frac{6}{6} = 1$ true c) $\frac{2}{3} = \frac{3}{4}$ false*	3.NF.3c 3.NF.3d	**3 pts.**	
7a–b Explains why $\frac{1}{4}$ is greater than $\frac{1}{6}$, even though 6 is greater than 4. *a) No; b) Explanations will vary, but should include at least one labeled sketch.*	3.NF.3d	**2 pts.** • 1 pt. for correct answer to part a (No) • 1 pt. for viable explanation with at least one labeled sketch that is relevant and reasonably accurate, in terms of showing the two fractions	
8a–b Partitions and shades in $\frac{2}{3}$ of one rectangle and $\frac{4}{6}$ of another. Indicates an understanding that the two fractions are equivalent. *a) Drawings will vary; b) Maria and Josie ate the same amount.*	3.NF.3a 3.NF.3b 3.G.2	**3 pts.** • 1 pt. each for shading in $\frac{2}{3}$ and $\frac{4}{6}$ on the strips with reasonable accuracy and correct labeling • 1 pt. for the correct answer to part b	
		Subtotal page 1	

Unit 7 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
9a Solves a two-step story problem involving multiplication and addition. Shows work. *40 flowers; work will vary.*	3.OA.7 3.OA.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using a viable strategy that could lead to the correct answer	
9b Chooses the equation that best represents the problem. *Choice 3: $(7 \times 4) + 12 = f$.*	3.OA.8	**1 pt.**	
10a Chooses the most reasonable estimate for the answer to a two-step story problem, and explains choice. *Choice 2: 280 fish; students' explanations will vary. If students select a different response, check for valid reasoning and correct rounding.*	3.OA.8	**2 pts.** • 1 pt. for the correct answer • 1 pt. for a sensible explanation	
10b Writes an equation to represent the problem. Uses a letter to stand for the unknown quantity. *Equations will vary. Examples include $323 - (7 \times 6) = f$; $323 - 42 = f$; $42 + f = 323$; $f + 42 = 323$.*	3.OA.8	**1 pt.** for an equation that accurately represents the problem	
10c Solves a two-step story problem that involves multiplication and subtraction. *281 fish; work will vary. Example: $7 \times 6 = 42$; $323 - 42 = 281$.*	3.OA.7 3.OA.8 3.NBT.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using a viable strategy that could lead to the correct answer	
11 Multiplies single digit numbers by multiples of 10. *240, 250, 480, 280*	3.NBT.3	**4 pts.**	
12 Uses an area model to illustrate the distributive property by sketching and solving 6×13. Shows work. *78; work will vary. See answer key.*	3.OA.5 3.NBT.3 3.MD.7c	**2 pts.** • 1 pt. for the correct answer • 1 pt. for using the base ten grid effectively to sketch and solve the combination	
13a–d Indicates whether multiplication equations involving the commutative, associative, and distributive properties are true or false. *True, False, True, True*	3.OA.5 3.OA.7	**4 pts.**	
		Subtotal page 2	
		Subtotal from page 1	
Total Score/Level of Proficiency*		**38 pts.**	

* **Meeting Standard** 29–38 points (75%–100% correct) **Approaching Standard** 19–28 points (50–74% correct) **Strategic** 10–18 points (25–49% correct) **Intensive** 9 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 3

Subject(s)	Mathematics
Grade/Course	Grade 3 / Mathematics
Unit of Study	Unit 8: Bridge Design and Construction: Data Collection & Analysis
Pacing	4 Weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
3.NF.1 Demonstrate an understanding of a unit fraction $1/b$ as 1 of b equal parts into which a whole has been partitioned, and a fraction a/b as a equal parts, each of which is $1/b$ of a whole.
3.NF.3d Compare two fractions with the same numerator or denominator; use the symbols >, =, and < to record comparisons of two

fractions.
3.MD.1 Tell and write time to the nearest minute.
3.MD.1 Measure time intervals in minutes; solve story problems involving addition and subtraction of time intervals in minutes.
3.MD.2 Estimate and measure mass in grams and kilograms; solve story problems involving addition, subtraction, multiplication, or division of mass measurements given in grams and kilograms.
3.MD.3 Make a scaled bar graph to represent a data set with several categories; solve one- and two- step comparison problems using data shown on a scaled bar graph with several categories.
3.MD.4 Generate measurement data by measuring lengths to the nearest half or fourth of an inch, and make a line plot to show the data.
3.MD.7b Find the area of a rectangle by multiplying its side lengths.
3.G.1 Identify rhombuses, rectangles, and squares as quadrilaterals; draw quadrilaterals that are not rhombuses, rectangles, or squares.
3.G.1 Identify shared attributes of shapes in different categories; group shapes in different categories according to shared attributes that define a broader category.
3.G.2 Partition shapes into parts with equal areas; express the area of each equal part of a whole as a unit fraction of the whole.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	**Concepts** *What must students* ***know****?*
1. Demonstrate an understanding of a unit fraction 1/b as 1 of b equal parts into which a whole has been partitioned, and a fraction a/b as a equal parts, each of which is 1/b of a whole. 2. Compare two fractions with the same numerator or denominator; use the symbols >, =, and < to record comparisons of two fractions. 3. Tell and write time to the nearest minute.	1. A fraction 1/*b* is the quantity formed by 1 part when a whole is partitioned into *b* equal parts. A fraction with a numerator of 1 is a unit fraction. 2. The larger the number in the denominator of a fraction, the smaller the unit fraction. 3. There are 60 minutes in an hour and each number on

	the clock represents one hour (the shorter hand) and 5 minute intervals (the longer hand).
4. Measure time intervals in minutes; solve story problems involving addition and subtraction of time intervals in minutes.	4. Addition and subtraction of time is based on 60 minutes in an hour, not our typical base-ten number system.
5. Estimate and measure mass in grams and kilograms; solve story problems involving addition, subtraction, multiplication, or division of mass measurements given in grams and kilograms.	5. The metric system is based on units of ten across different measurements; length (meter), mass (grams) and volume (liter).
6. Make a scaled bar graph to represent a data set with several categories; solve one- and two-step comparison problems using data shown on a scaled bar graph with several categories.	6. Data can be visually represented and analyzed using bar graphs.
7. Generate measurement data by measuring lengths to the nearest half or fourth of an inch, and make a line plot to show the data.	7. Measuring with accuracy requires measuring to fractions of an inch. Measurements collected can be represented visually using a line plot.
8. Find the area of a rectangle by multiplying its side lengths.	8. Area of a rectangle is a measurement of the space inside the shape. It can be calculated by multiplying the measurement of the length of a side by the measurement of the width.
9. Identify rhombuses, rectangles, and squares as quadrilaterals; draw quadrilaterals that are not rhombuses, rectangles, or squares.	9. There are special quadrilaterals named for attributes of their sides and angles. Not all quadrilaterals have special names. Some quadrilaterals have more than one special name, (a square is a parallelogram, rhombus and rectangle).

10. Identify shared attributes of shapes in different categories; group shapes in different categories according to shared attributes that define a broader category. 11. Partition shapes into parts with equal areas; express the area of each equal part of a whole as a unit fraction of the whole.	10. Shapes can be categorized by like attributes such as number of sides, length of sides, measurement of angles, the presence or absence of parallel or perpendicular sides, etc. 11. One model for fractions involves identifying part of a whole in which the denominator refers to the size of the part in relationship to the whole.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why is geometry, measurement and data collection and analysis important in the engineering and design of man-made structures in our world?	1. One reason for an applied math unit about bridges is that many of the variables that influence the length and strength of bridge designs can be quantified. As students investigate these variables, they estimate and measure the spans of their bridges in inches or centimeters, and the strength of their bridges in grams, kilograms, milliliters, and liters. Students study how different shapes influence the strength and structure of bridges and apply this understanding to their designs. Throughout the unit, students organize their data using line plots, picture graphs, and bar graphs, then analyze the results to determine the factors that influence bridge strength. Students also plan and monitor their own time during the building sessions.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable:

Standard 1.4.a Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems. **Standard 1.4.b** Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

Informational Texts:
• **Informational Books:**
    ○ Twenty-One Elephants and Still Standing
    ○ Bridges and Tunnels
    ○ Bridges!
    ○ How Do Bridges Not Fall Down?
Online Resources / Websites:
• **Games:**
    ○ Fractis
• **Websites:**
    ○ PBS Bridges
    ○ Bridge building challenge

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Area:** the total number of square units needed to cover a two-dimensional surface. **Bar Graph:** a graph that uses horizontal or vertical bars to show frequency of data. **Circle:** a two-dimensional (flat) shape made by drawing a curve that is always the same distance from a point called the center. **Dimension:** the length, width, or height of a figure. **Hexagon:** a two-dimensional (flat) shape with 6 sides. **Line Plot:** a horizontal number line that uses markings (such as an X or a dot) to show data points above their values on the line. **Mean:** the sum of all numbers in a data set divided by the number of data points; typically called the “average”. **Median:** the middle value of an ordered set of numerical data; in a set with an even number of data points, the median is the average of the two middle points.

Mode: the value (or values) that appear most often in a set of data; there may be no mode, one mode, or multiple modes in a single set of data.
Outlier: a value in a set that is much higher or much lower in value than other numbers in the set.
Parallelogram: a two-dimensional (flat) shape with 4 sides, with both pairs of opposite sides parallel.
Partition: to divide into portions or pieces.
Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference.
Picture Graph: a graph that uses pictures or symbols to show frequency of data.
Quadrilateral: a two-dimensional (flat) shape with 4 sides.
Range: the difference between the greatest and least values in a data set.
Rectangle: a two-dimensional (flat) shape with two pairs of parallel sides (4 sides total) and 4 right angles.
Rhombus: a two-dimensional (flat) shape with 4 congruent sides.
Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles.
Trapezoid: a two-dimensional (flat) shape with 4 sides; exactly 1 pair of which are parallel.
Triangle: a two-dimensional (flat) shape with 3 sides.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

In the final unit of the year, students learn about different kinds of bridges by reading nonfiction, looking at pictures, doing research, and building their own model bridges. This unit integrates mathematics and science with a primary focus on designing and building model bridges, which are then tested in systematic ways to collect data. Students graph and analyze the data, finding the range and mean, to make conjectures and draw conclusions about effective bridge design and construction.

Week 1: Introducing Bridges

Students learn background information about the different kinds of structures and forces at play in various bridge designs. They read nonfiction text, collect pictures, and make charts to study the first two basic kinds of bridges: beam and arch. During this introduction, students use their bodies to investigate how structures balance themselves and support weight. They also build a variety of models to explore how beam and arch bridges work, experimenting with different shapes and areas. After constructing these models, the class tests their designs, collects data, creates a bar graph, and analyzes the results.

Lesson One: What We Know and Wonder About Bridges
Students contribute what they know and wonder about bridges to a class chart. Then they discuss how math might be used in bridge design, construction, and maintenance. Finally, they use their bodies to discover which geometric shapes make strong and stable bridge structures capable of supporting heavy loads. At the end of the session, students summarize what they have learned in their math journals.

Lesson Two: Three Kinds of Bridges
The teacher reads pages 2–3 of Kids Discover: Bridges together with the class. Students then discuss the design features of beam, arch, and suspension bridges and add ideas to the Know, Wonder, Learned chart. Then the teacher introduces two new Work Places focusing on measurement. Students spend the rest of the session doing Work Places.

Work Places 8A & 8B Measurement Olympics
Work Places in Unit 8 use an Olympics theme to engage students in games focusing on measurement skills. In Work Place 8A Weight Lifting, students estimate and then measure the mass of an object in grams. They estimate how much of that object (measured by mass in grams) they think they can grab in one hand, then make a grab and record the actual results. In Work Place 8B Wacky Discus, students calculate all of the possible pairs of dimensions for a rectangle of a given area. They choose one set of dimensions to measure and cut out to make their own Wacky Discus. Finally, they throw the discus as far as they can and measure the distance it travels.

Lesson Three: Researching and Building Beam Bridges
The teacher reads pages 4–5 of Kids Discover: Bridges together with the class. Using their bodies, students explore the general structure of beam bridges. Then students collaborate on building a beam bridge using a variety of materials. The class discusses their observations and experiences and compiles information about beam bridges onto a class chart.

Lesson Four: Building and Testing Paper Beam Bridges
Students explore tension and compression forces using a single piece of copy paper. They construct a basic beam bridge from paper and test the strength of their design. Then they discuss the features of their design, including the area of the span and the shapes used. Then class data for bridge areas and load limits is collected and recorded, and students are invited to reflect on the results.

Lesson Five: Researching and Building Arch Bridges
The teacher reads pages 6–7 of Kids Discover: Bridges together with the class. Students use their bodies and strips of cardstock to explore the form of an arch bridge. They test the strength of an arch bridge, graph the results, and discuss why there are discrepancies in the data collected. The class discusses their observations and experiences and compiles information about beam

bridges onto a class chart.
Week 2: Investigating Structures in Bridges Students build a variety of models to explore how suspension bridges work, using liquid volume to test the load limits. Students collect data, help the teacher create a line plot, and analyze the results. In Session 4, students sort images of bridges by type, create a class pictograph, and use the data to independently create their own scaled bar graph. Session 5 turns students' attention to geometry, where student teams sort pictures of bridges by shapes and features and then guess each other's categories. **Lesson Six: More Measurement Olympics** **Introducing Work Places 8C & 8D More Measurement Olympics** Two new Work Places continue the Olympics theme with events focusing on measurement skills. The first game, Speed Skating, allows students to work with perimeter and time measurement skills. The second game, Curling, has students partitioning different shapes into equal areas, then "curling" gram cubes into the partitions to earn unit fraction scores to a total of 1. **Lesson Seven: Introducing Suspension Bridges** Students investigate how suspension bridges support weight. In teams of three, they use a piece of string and books to experiment with the interplay of compression and tension. Teams then test the load limit of their models, using liquid volume as the measure. At the end of the session, they record observations about their suspension bridge experiments in their journals. Students will build on these experiences in Session 3. **Lesson Eight: Researching and Building Suspension Bridges** The teacher reads pages 8–9 in the Kids Discover: Bridges magazine together with the class. Then students build their own suspension bridges and discuss what worked, what didn't, and why. Students collect data on their bridges' span length, create a line plot, and analyze the results. The class discusses their observations and experiences and compiles information about suspension bridges onto a class chart. **Lesson Nine: Sorting and Graphing Bridges** Students share the examples of bridges they found in the Looking for Bridges Home Connection, then make a picture graph to sort their collected bridges into three types. They use the class charts developed in previous sessions to help determine the correct categories. Then they independently create a scaled bar graph based on the class picture graph. **Lesson Ten: Exploring Shapes in Bridges**

Students work in small groups to sort and classify pictures of bridges by their shapes and features. Then they look at other groups' sorted pictures and try to determine the attributes by which they are sorted. Students complete a worksheet independently to demonstrate what they understand about shapes in bridges. The teacher makes note of their sorting methods, use of vocabulary, drawing, and identification of shapes as a way to informally assess understanding of geometry concepts.

Week 3: Planning, Building & Analyzing Bridges
Students synthesize what they've learned about bridges so far by planning and then building two bridges, focusing first on strength and then on length (span). They collect data on their bridges, help the teacher create line plots and a scatter plot, and analyze the results. Students reflect on the class data to make conjectures about successful bridge designs and materials.

Lesson Eleven: Planning Strong Bridges
Students build and partition squares and rectangles into triangles to experience how triangles increase stability and strength. Next they discuss the ground rules for the bridge-building strength challenge, which begins in Session 2. They review how to set up a scientific experiment in which only one variable is measured, and determine what constitutes a fair test of a bridge's strength. Teams of three then plan how they will build the bridge, the time they will spend on each task, and the responsibilities of each member of the team.

Lesson Twelve: Building Strong Bridges
Students review their plans and decisions from yesterday's session and determine the timing for each task they'll complete during today's session. They then spend the rest of the session building their strong bridges.

Lesson Thirteen: Strong Bridge Trial and Analysis
Students sketch the bridges they built during yesterday's session and then identify and outline some of the shapes they used. Student teams then retest the strength of their bridge for the class. They collect the data on a chart and create a bar graph to assist in visual analysis of the data set. Students make conjectures about bridge designs and features based on the data.

Lesson Fourteen: Planning and Building Long Bridges
Students spend today's session designing, constructing, and testing the longest bridge they can make with the available materials. These bridges must support their own weight and hold 60 grams placed in the center of the span. Students again plan and monitor their own time during the building portion of the session. At the end of the session, they take measurements and sketch their bridges.

Lesson Fifteen: Long Bridge Analysis, Part 1
Students test and measure their long bridges. The data is collected onto a class chart, and the class works together to help the teacher

represent the data in two different line plots. Finally, students reflect on the class data to make conjectures about successful bridge designs and materials. They spend any remaining time at Work Places.

Lesson Sixteen: Long Bridge Analysis, Part 2
In this challenge session, students help calculate the arithmetic mean of their bridge lengths, considering contextual uses for average values as they do so. The class develops a scatter plot using the bridge span and deck thickness data from the last two sessions. Students work in pairs to interpret data from the scatter plot, then consider advantages of different graph types in analyzing data. They spend any remaining time at Work Places. Finally, the teacher introduces the Most & Least Fractions Home Connection.

Week 4: Demonstrating Our Learning About Bridges
Student teams build the longest, strongest bridge model that they can. Teams measure and test their bridges, assess their work, and explain the challenges they faced and how they overcame them. Students independently draw a detailed sketch of their bridges, identify the shapes they used in the construction, and reflect on the building process. The class analyzes the data and determines whether the average load limit and span length increased over previous bridge designs. An optional activity offers an opportunity to share their work with visitors.

Lesson Seventeen: Planning Longer and Stronger Bridges
In this session, student teams apply what they learned in earlier sessions to plan longer, stronger bridges. Teams set their own additional goals for their bridge designs, then plan how they'll use their time during the actual build next session. Students that finish their plans before the end of the session go to Work Places.

Lesson Eighteen: Building Longer and Stronger Bridges
In this session, student teams apply what they learned in earlier sessions to build longer, stronger bridges. They work to attain their own additional goals for their bridge designs and monitor the use of their time throughout the building and testing process. At the end of the session, students reflect upon their goals and their approaches to reaching them.

Lesson Nineteen: Measuring and Drawing the Final Bridge
Students draw a detailed sketch of their bridges, take measurements, and identify the different shapes they used in the construction. Teams then test their bridges and share what they learned with the class. Students spend any remaining time at Work Places.

Lesson Twenty: Analyzing Final Results & Drawing Conclusions About Bridges
Students work independently to create graphs of either the span or load data collected in Session 3. They find the range and mean for the data and then share their strategies and check their figures as a class. An optional Bridges Showcase gives students an

opportunity to prepare their work for sharing with friends and family members or students from other classrooms.

Interdisciplinary / Real World / Global Connections

- Unit 8 provides students with the opportunity to connect geometry, measurement, fractions, and computation with science as they plan and build bridges. Students will become familiar with the engineering and design process which they can apply to solve problems in and out of school.

- Science concepts are woven throughout this final unit. Next Generation Science Standards and Engineering Design are addressed throughout the bridge building activities.

Standard	
3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☐ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation
Challenge: ● As students design and build their bridges there are natural ways to extend this to challenge students. Ask students to change one variable- make your bridge longer, lighter, wider, etc.- and require students to describe how this change affects the strength of the structure. ● Ask students to create their own version of a work place and teach another pair of students how to play. ● See "Game Variations" in work place guides. ● See "Assessment and Differentiation" in work place teacher masters.
Support: ● Suggest specific work places for students who need to revisit previously learned skills. ● Allow access to Word Resource cards and/or the vocabulary app. ● Students should work with visual representations of mathematical ideas. ● If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulatives first. ● Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution. ● Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.
MLL (Multilingual Learners)**:** ● Provide students with nonfiction text, websites and realia showing different types of bridges and allow them to use these books to help them explain their designs using content vocabulary in the texts. ● Have students create personal visual dictionaries highlighting the meaning of important vocabulary words and supporting the language with picture examples of each term. Allow students access to this support on all assignments. ● Allow access to Word Resource cards and/or the vocabulary app. ● Pair MLL students with native English-speaking peers to provide opportunity for modeled language and for MLL students' practice speaking with the new vocabulary. ● Provide students with work place sentence frames written out on sentence strips. Keep the sentence strips in a bin or folder with work place materials so they are easily accessible. ● Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. MLLs can participate and show that they understand a concept, or agree or disagree with an idea, without having

to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.

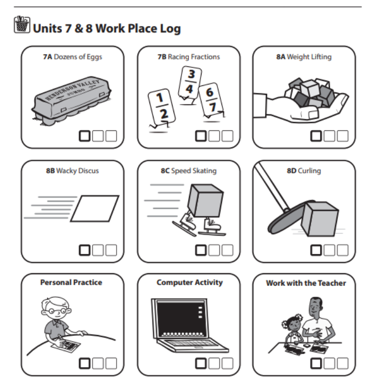
- Pre-teach vocabulary in ways that connect to students' prior knowledge.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Work Places
- Home Connections
- Student Book Class Work



Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Multiple Journal Entries (Graphing. Plotting, Drawing and Analysis of Bridges)
- Planning and Building Bridges (making conjectures about successful bridge designs and materials)
- Number Corner End-of-year Checkup

Number Corner Checkup 4 Scoring Guide

Item	CCSS	Points Possible	Student Name
1 Solves 20 multiplication facts through 10 × 10 in 1 minute or less. *24, 14, 16, 36, 25, 28, 8* *0, 63, 35, 30, 12, 48, 42* *60, 54, 24, 49, 56, 81*	3.OA.7	4 pts. — 18–20 correct 3 pts. — 16–17 correct 2 pts. — 14–15 correct 1 pt. — 12–13 correct 0 pts. — 11 or fewer correct	
2 Writes a story problem to match the equation 12 × 3 = 36. *Responses will vary. Example: There are 12 kids and each kid has 3 crayons. How many crayons in all?*	3.OA.1	**2 pts.** • 1 pt. for story problem that involves multiplication • 1 pt. for including a question that indicates what needs to be solved	
3 Writes a story problem to match the equation 27 ÷ 3 = 9. *Responses will vary. Example: Mrs. Ortiz had 27 markers. She divided the markers evenly into 3 baskets. How many markers were there in each basket?*	3.OA.2	**2 pts.** • 1 pt. for story problem that involves division • 1 pt. for including a question that indicates what needs to be solved	
4a–d Shows understanding of the commutative and distributive properties, identifies patterns on the multiplication table and explains patterns by referring to basic properties of multiplication. *Responses will vary; see answer key.*	3.OA.5 3.OA.7 3.OA.9	**4 pts.** • 1 pt. for each sensible and reasonably complete response	
5 Solves a story problem involving the sharing interpretation of division. Shows work. *7 brownies. Work will vary.*	3.OA.2 3.OA.3	**2 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to the correct answer	
6 Solves a story problem involving the grouping interpretation of division. Shows work. *They can decorate 4 tables (4 groups of 8 balloons). Work will vary.*	3.OA.2 3.OA.3	**2 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to the correct answer	
7 Demonstratse an understanding of the commutative and associative properties of multiplication. *Agree with Cho; explanations will vary. Example: When you do multiplication, you can multiply the numbers in any order, and the answer stays the same.*	3.OA.5	**2 pts.** • 1 pt. for correct answer (agree with Cho) • 1 pt. for explanation that demonstrates understanding of properties	
8a–b Solves a two-step story problem involving addition and subtraction. Shows work. Uses estimation or rounding to assess the reasonableness of answer. *a) $160; work will vary.* *b) Responses will vary.*	3.OA.8 3.NBT.2	**3 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to the correct answer • 1 pt. for using some form of rounding, estimation, or mental computation to assess reasonableness of answer	
9a–d Solves for the unknown in varying positions in a division or multiplication equation. *5, 48, 4, 18*	3.OA.4 3.OA.6 3.OA.7	**4 pts.** 1 pt. for each correct answer	
		Subtotal page 1	

Number Corner Checkup 4 Scoring Guide page 2 of 2

Item	CCSS	Points Possible	Student Name
10 Puts fractions, whole numbers, mixed numbers, and improper fractions on a number line. *Numbers should appear in the following order along the line: [illegible]*	3.NF.2 3.NF.3c	**1 pt.** for placing all 8 numbers in the correct order along the line, and in reasonably accurate locations with respect to each other	
11 Uses a number line to compare fractions. *Sketches will vary. See answer key.*	3.NF.3d	**1 pt.**	
12 Solves a story problem in which a factor or quotient is unknown. *x = 8 cm; work will vary.*	3.OA.4	**2 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to the correct answer	
13a–b Uses the area model to illustrate the distributive property. *Color the grid as shown on answer key; positioning of drawing on grid will vary.* *a) 7 × 7 = 49* *b) Statements 1, 3, and 4.*	3.MD.7c	**3 pts.** • 1 pt. for shading in the grid accurately • 1 pt. for writing a multiplication equation that accurately represents the situation • 1 pt. for selecting the 3 statements that are true (and not selecting the 1 that is false)	
14 Multiplies by 10 or multiples of 10 using strategies based on place value or properties of multiplication to determine the area of a rectangle. *The rectangles have the same area: 200 square units. Work will vary.*	3.NBT.3 3.MD.7b	**2 pts.** • 1 pt. for correct answer (Rectangles A and B have the same area) • 1 pt. for a reasonable explanation that includes the area of each rectangle	
15a–b Measures 7 lengths to the nearest quarter-inch. Displays the data on a line plot. *a) [illegible]* *b) Some elements of students' line plots, such as the title and the label for the horizontal axis will vary.*	3.NF.2 3.MD.4	**4 pts.** (see note below) • 1 pt. for measuring all the lengths accurately • 1 pt. for labeling the marks along the number line accurately • 1 pt. for correctly showing each piece of data on the line plot • ½ pt. each for title and label that are accurate and informative	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**38 pts.**	

* **Meeting Standard** 29–38 points (75%–100% correct) **Approaching Standard** 19–28 points (50–74% correct)
Strategic 10–18 points (25–49% correct) **Intensive** 9 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 1: Multiplicative Thinking
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

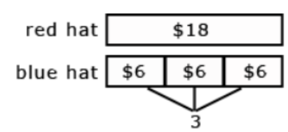
Mathematical Practices
(Practices in bold are emphasized in this unit)

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
4.OA.1 Write a multiplication equation to represent a verbal statement of a multiplicative comparison.
4.OA.2 Solve story problems involving a multiplicative comparison using multiplication or division.
4.OA.4 Find all factor pairs for a whole number between 1 and 100.

4.OA.4 Demonstrates an understanding that a whole number is a multiple of each of its factors.
4.OA.4 Determine whether a whole number between 1 and 100 is prime or composite.

Supporting Standards:
4.MD.1 Identify the relative sizes of centimeters, meters, and kilometers; grams and kilograms; ounces and pounds; milliliters and liters; seconds, minutes and hours.
4.MD.1 Express a measurement in a larger unit in terms of a smaller unit within the same system of measurement.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Make a comparison statement to match a multiplication equation.	1. Students should be able to identify and verbalize which quantity is being multiplied and which number tells how many times.
2. Solve story problems involving multiplicative comparison using multiplication or division.	2. These standard calls for students to translate comparative situations into equations with an unknown and solve. ($6 x 3 = $\boxed{}$)  A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? In solving this problem, the student should identify $18 as the quantity being divided into shares of $6.
3. Find all factor pairs for a whole number between 1 to 100 and determine whether a whole number between 1 to 100	3. Students demonstrate understanding of factors and multiples of whole numbers. This standard also refers to

is prime or composite.	prime and composite numbers.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How are multiplication and division related to each other?	1. The properties of multiplication and division help us solve computation problems easily and provide reasoning for the choices we make in problem solving. a. Multiplication may be used to find the total number of objects when objects are arranged in equal groups and may be represented by rectangular arrays/area models. b. Division is used to break the total apart into equal groups.
2. What patterns do I notice when I am multiplying whole numbers that can help me multiply more efficiently?	2. A whole number is a multiple of each of its factors. All whole numbers can be made up of 1 or more factor pairs.
3. What is the difference between a prime and a composite number?	3. Numbers with exactly 2 factors, 1 and the number itself, are prime. Numbers with more than 2 factors are composite.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
Books / Media:

- Multiplication and Division Books
- Young Mathematicians at Work: Constructing Multiplication and Division
- The Best of Times: Math Strategies that Multiply
- You Can Count on Monsters: The First 100 Numbers and Their Characters
- Jim and the Beanstalk
- How Long or How Wide?: A Measuring Guide
- Measurement Books
- Millions to Measure

Online Resources / Websites:
- Math Learning Center: Number Line App
- Math Learning Center: Number Pieces App
- Math Learning Center: Partial Product Finder
- Teacher/Student Tool: Factorize
- Game: Bunny Times
- Game: Mostly Postie
- App: Math Tappers

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- **Area**: The total number of square units needed to cover a two-dimensional surface.
- **Area model of multiplication:** A model in which two numbers being multiplied are represented by the dimensions of a rectangle, and their product is represented by the area of the rectangle.
- **Array:** An arrangement consisting of equal rows and equal columns.
- **Centimeter (cm):** A metric unit of length equal to 1⁄1 of a meter or about 2⁄5 of an inch.
- **Commutative property of multiplication:** The property by which the product remains unchanged no matter how the numbers being multiplied are ordered, so that a × b = b × a.
- **Composite number:** A number with more than two factors (if a number has exactly two factors, 1 and itself, it is a prime number).
- **Cup:** A customary unit of capacity equal to 8 fluid ounces.

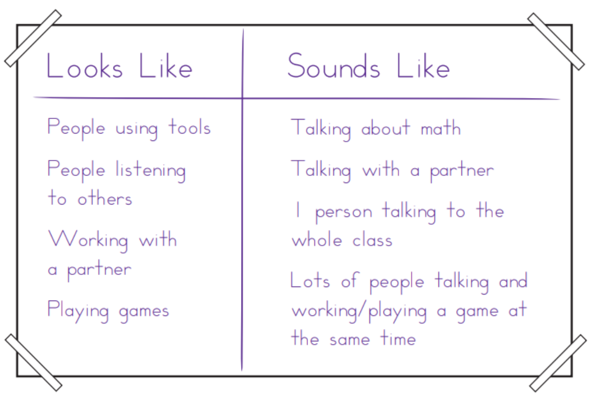
- **Customary system:** The system of measurement used in the United States; includes units for measuring length, capacity, weight, and temperature.
- **Dimension:** The length, width, or height of a figure.
- **Divide:** To break or split into equal parts; to determine how many times one number goes into another.
- **Equation:** A mathematical statement asserting that two quantities have the same value.
- **Factor pair(s):** The pairs of whole numbers that can be multiplied to produce a given whole number (e.g., 15 has two factor pairs: 1 and 15, and 3 and 5).
- **Factor:** A whole number that divides evenly into another number.
- **Gallon (gal.):** A customary unit of capacity equal to 4 quarts or 16 cups or 128 fluid ounces.
- **Gram (g):** A metric unit of mass equal to one-thousandth of a kilogram or about the weight of a standard paperclip.
- **Inch (in.):** A customary unit of length equal to 1⁄12 of a foot.
- **Kilogram (kg):** A metric unit of mass equal to 1,000 grams or about 2.2 pounds.
- **Liquid volume:** The measure of the amount of liquid a container will hold.
- **Liter (l):** A metric unit of capacity equal to 1,000 milliliters or about a quart.
- **Mass:** A measure of the amount of matter in an object measured in grams, kilograms, etc.
- **Meter (m):** A metric unit of length equal to 100 centimeters or about 39 inches.
- **Metric system:** A system of measurement based on tens.
- **Milliliter (ml):** A metric unit of capacity equal to one-thousandth of a liter.
- **Multiple:** A number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3.
- **Multiply:** To find the product of.
- **Ounce (oz.):** A customary unit of weight equal to one-sixteenth of a pound.
- **Pint (pt.):** A customary unit of capacity equal to one-eighth of a gallon or 2 cups or 16 fluid ounces.
- **Pound (lb.):** A customary unit of weight equal to 16 ounces.
- **Prime number:** A number with exactly two different factors—itself and 1.
- **Product:** The result of multiplying two or more numbers; in the array model, the product is the area of the array.
- **Quart (qt.):** A customary unit of capacity equal to one-fourth of a gallon or 4 cups or 32 fluid ounces.
- **Quotient:** The result or answer in division; the number of times one quantity goes into another.
- **Ratio table:** A model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
- **Unit:** Another name for 1 (the units' column is the same as the ones column); also, a standard amount in which attributes (length, duration, mass) can be measured and quantified.

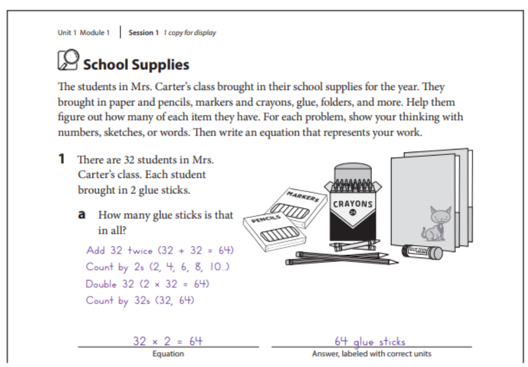
Learning Plan

Overview and Key Learning Events and Instruction Per Week

Unit 1 begins the year with a study of multiplication and division, focusing in particular on models, strategies and multiplicative comparisons. In Module 1, students use open number lines, arrays, and ratio tables. They also solve multiplication and division story problems and participate in their first math forum. In Module 2, they use the area model to investigate factors and multiples and prime and composite numbers. They also review strategies for finding single-digit multiplication facts. Module 3 has them working with factors and products as well as multiplicative comparisons and equations. Module 4 extends the idea of multiplicative comparison into the arena of measurement, as students develop deeper understandings of the relative sizes of metric units for length, mass, and liquid volume.

Week 1, Models for Multiplication & Division: In Module 1, the teacher works to set the tone for the year and to build community within the class. Students brainstorm what the class should look like, and sound like in Session 1, extending and refining their list as the module continues. Also in Session 1, the teacher launches a multi-day investigation in which students determine the number of school supplies collected in a fictional fourth grade classroom. This context allows students to review and extend their understanding of multiplication strategies, concepts, and models including open number lines, ratio tables, and arrays. Students take the Unit 1 Pre-Assessment in Session 3 and reflect on their work in Session 4. They participate in the first math forum of the year in Session 6, sharing their work on a variety of story problems from Session 5.




Unit 1 Module 1 | Session 1 *1 copy for display*

School Supplies

The students in Mrs. Carter's class brought in their school supplies for the year. They brought in paper and pencils, markers and crayons, glue, folders, and more. Help them figure out how many of each item they have. For each problem, show your thinking with numbers, sketches, or words. Then write an equation that represents your work.

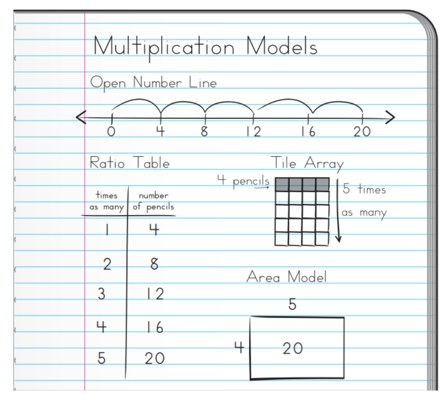
1 There are 32 students in Mrs. Carter's class. Each student brought in 2 glue sticks.

a How many glue sticks is that in all?

Add 32 twice (32 + 32 = 64)
Count by 2s (2, 4, 6, 8, 10...)
Double 32 (2 × 32 = 64)
Count by 32s (32, 64)

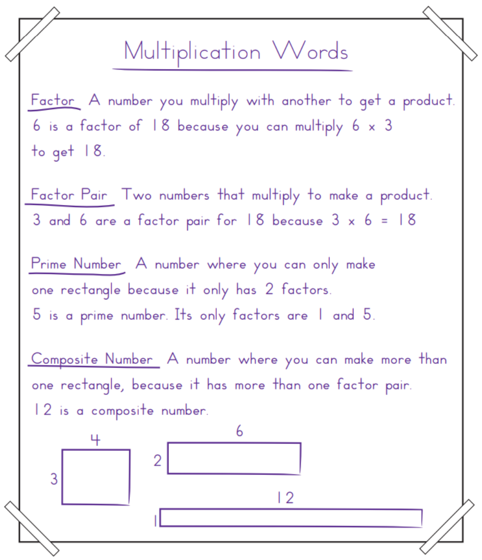
32 × 2 = 64 — Equation

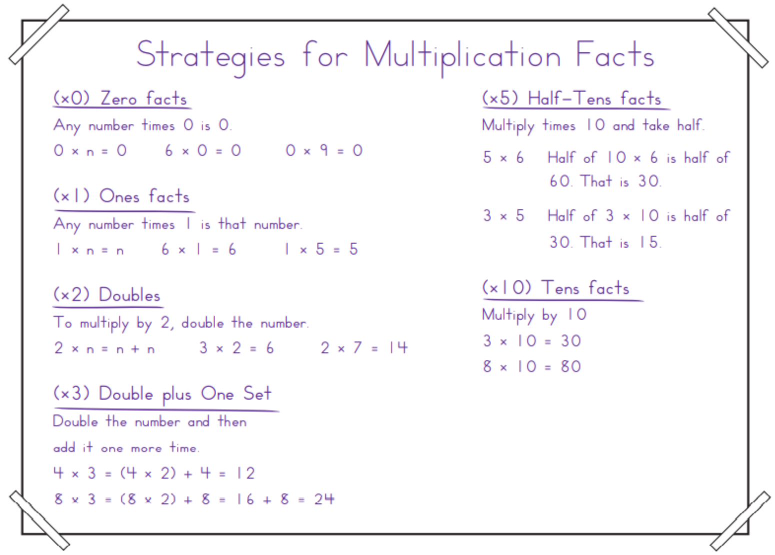
64 glue sticks — Answer, labeled with correct units



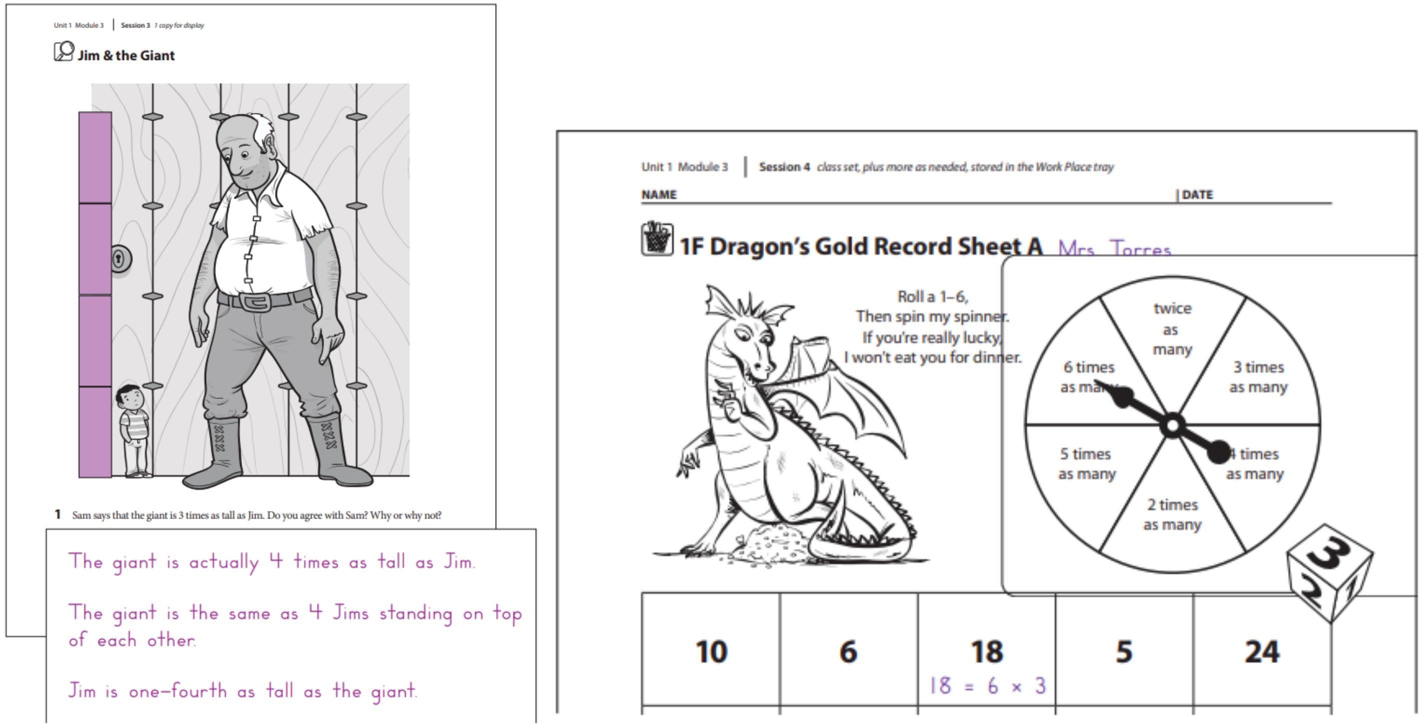
Remind students that they will use these models for multiplicative situations throughout the year.

Week 2, Primes & Composites: Students use tile arrays to investigate factors of numbers and determine whether numbers are prime or composite. They consider multiplication fact strategies introduced in third grade and use open number lines, ratio tables, and the area model to review them. The Work Place activities introduced in this module also provide practice with multiplication facts and strategies.

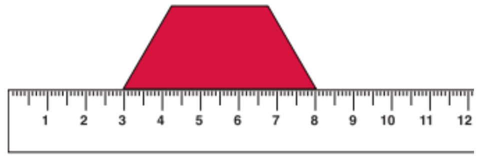




Week 3, Multiplicative Comparisons & Equations: This module focuses on factors, products, multiplication comparisons, and equations, and introduces students to two new work place games. In Products Four in a Row, students develop strategies to choose factors that will give them the most advantageous products. Then in Dragon's Gold, they learn to verbalize and record statements of multiplicative comparison. To help teachers evaluate student progress, the class takes a multiplication and division checkpoint in Session 2. In Session 4, students spend time engaged in Work Places, giving the teacher another opportunity to differentiate instruction as students practice the skills that will be addressed by the Unit 1 Post-Assessment in Session 5.



Week 4, Measurement Experiences: This module provides hands-on experience with measurement as students explore linear measurement, mass, weight, and liquid volume, and review the definitions and units of measure for each category. They learn about and use various tools for measurement and match the units of measure with each tool. Students also participate in investigations that enable them to better identify the relative sizes of various units of measure. While there is not an assessment in this module, the Daily Practice pages provide a snapshot of how students are doing with the skills and concepts in these three sessions.



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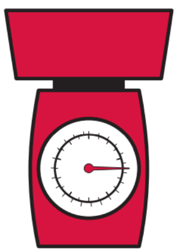
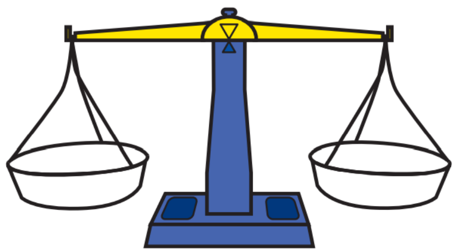
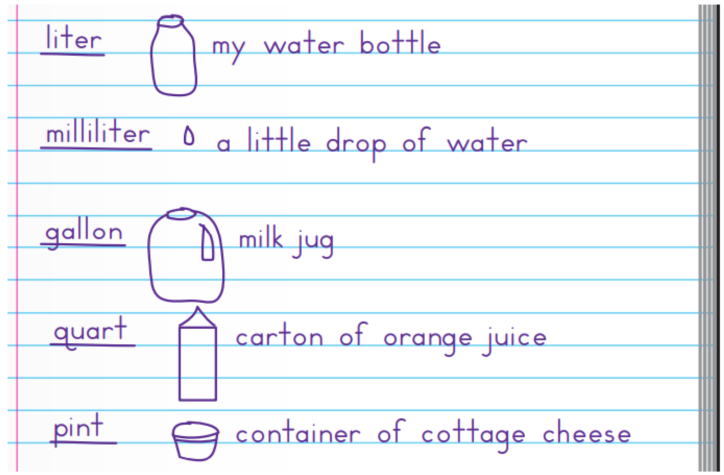

platform scale


pan balance

Measurement Words

Mass	Weight
◦ usually measured in metric units: grams & kilograms	◦ can be measured in metric units, but in the U.S., we often use customary units: ounces & pounds
◦ often measured on a balance scale	◦ measured on a scale that shows numbers
◦ when we measure mass, we find out how much "stuff" there is in an object	◦ when we measure weight, we find out how heavy something is



Interdisciplinary / Real World / Global Connections
● Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.) ● By working in this way with numbers, you help students reason both abstractly (numbers) and quantitatively (arrays and context) about factors, products, and prime and composite numbers. ● When you give students the responsibility of defending and amending their own assertions, while also considering the thinking of others, you help them construct viable arguments and critique the reasoning of others. These kinds of discussions dramatically deepen students' understanding of the mathematical concepts in question. ● Students look for and make use of structure when they examine the arrays and explore strategies that can be used to multiply any number by 6. The structure of the arrays makes evident the relationships among multiplying by 10, 5, and 6, which helps students understand this, and other, generalized strategies for multiplying by a particular number.

Unit 1

Jim and the Beanstalk by Raymond Briggs

You Can Count on Monsters: The First 100 Numbers and Their Characters by Richard Evan Schwartz

Young Mathematicians at Work: Constructing Multiplication and Division by Catherine Twomey Fosnot, Maarten Dolk

The Best Of Times by Gregory Tang

How Long or How Wide?: A Measuring Guide (Math Is Categorical) by Brian P. Cleary

Millions to Measure by David M. Schwartz, Steven Kellogg

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in work place guides

- See “Assessment and Differentiation” in work place teacher masters

Support:
- When applicable give students smaller numbers to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- See “Game Variations” in work place guides
- See “Assessment and Differentiation” in work place teacher masters

ELL:
- Have pairs of ELL students observe another pair of students playing work places before playing it themselves.
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Pre-Assessment
- Multiplication and Division Checkpoint
- Work Places
- Home Connections
- Student Book Class Work
- Number Strings

NAME | DATE

Unit 1 Pre-Assessment page 1 of 3

1 Complete the chart.

	a List all the factors of the number.	**b** List two multiples of the number. multiples may vary	**c** Write P if the number is prime or C if the number is composite.
12	1, 2, 3, 4, 6, 12	12, 24, 36, 48, 60...	C
5	1, 5	5, 10, 15, 20, 25...	P

2 Write a prime number in the space below and tell how you know it is prime.
Answers will vary.
Example: 7 is a prime number.
It is prime because it has only two factors, itself and 1.

3 Write a composite number in the space below and tell how you know it is composite.
Answers will vary.
Example: 6 is a composite number.
It is composite because it has factors other than itself and 1.
2 and 3 are also factors of 6.

4 The equation $5 \times 7 = 35$ can mean:
- ○ 35 rulers are 5 rulers and 7 rulers put together
- ● 35 pencils are 7 times as many as the 5 pencils at the green table
- ○ 35 markers are 5 markers less than 7 markers
- ○ 5 erasers split into 7 groups is 35 erasers

5 Fill in the bubbles beside the two equations that best represent this situation: Marcus has 15 toy cars. That is 3 times as many as his brother Craig has. How many toy cars does Craig have? (In the equations below, *c* stands for Craig's toy cars.)

● $15 = 3 \times c$ ○ $15 \times 3 = c$ ○ $15 - 3 = c$ ● $15 \div c = 3$

(continued on next page)

NAME | DATE

Unit 1 Pre-Assessment page 2 of 3

6 Write and solve a multiplication equation for each of these problems.
Equations will vary. Examples shown below.

a Eric is 11 years old. Eric's dad is 3 times older than Eric. How old is Eric's dad?
$3 \times 11 = 33$; Eric's dad is 33 years old.

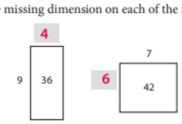
b Amber bought a pair of pants and a pair of shoes. The shoes cost 3 times as much as the pants. The pants cost $15. How much did the shoes cost?
$3 \times 15 = 45$; The shoes cost $45.

c Jamal bought a book and a CD. The book cost $14. The CD cost $7. How many times more than the CD did the book cost?
$2 \times 7 = 14$ The book cost 2 times as much the CD.

7 Fill in the blanks to complete this ratio table.

Number of Students	Number of Folders
1	6
2	12
4	24
5	30
10	60
11	66

8 Find and write in the missing dimension on each of the rectangles below.



9 Fill in the blanks.

a

7	5	6	4	10	3	50
× 8	× 8	× 9	× 8	× 22	× 7	× 4
56	40	54	32	220	21	200

b $9 \times \underline{10} = 90$ $4 \times 20 = \underline{80}$ $7 \times \underline{4} = 28$ $\underline{6} \times 10 = 60$

(continued on next page)

NAME | DATE

Unit 1 Pre-Assessment page 3 of 3

10 Solve each of the story problems below. Show your thinking with numbers, sketches, or words. Then write an equation that represents your work, and record the answer, labeled with the correct units.

a Each of the 4 students at the red table has 8 markers. The class has 5 times as many markers as the entire red table. How many markers total does the whole class have? **Work will vary.**

Equations will vary. Example: $(8 \times 4) \times 5 = 160$
Equation

The class has 160 markers.
Answer, labeled with correct units

b Abby saw 3 rows of crayons in her 24-count crayon box. How many crayons are in each row? **Work will vary.**

Equations will vary. Example: $24 \div 3 = 8$
Equation

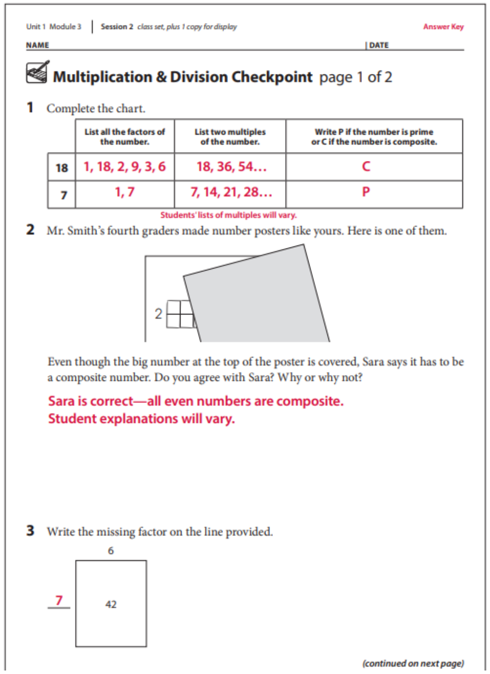
There are 8 crayons in each row.
Answer, labeled with correct units

11 The green table has 5 students and each student brought 6 folders. The red table group has 6 students and each student brought 8 folders. How many folders do both groups have together?

a Solve the problem above. Show your thinking with numbers, sketches, or words. You do not need to write an equation for this problem.
Work will vary. Example:
$5 \times 6 = 30$ $6 \times 8 = 48$
$30 + 48 = 78$ folders in all

b Which equation best represents this story problem? (The letter *f* stands for the number of folders both groups have together.)

- ● $(5 \times 6) + (6 \times 8) = f$
- ○ $5 + 6 + 6 + 8 = f$
- ○ $((5 \times 6) + (6 \times 8)) \div 11 = f$
- ○ $(6 \times 8) - (5 \times 6) = f$



Unit 1 Module 3 | Session 2 *class set, plus 1 copy for display* — Answer Key

NAME | DATE

Multiplication & Division Checkpoint page 1 of 2

1 Complete the chart.

	List all the factors of the number.	List two multiples of the number.	Write P if the number is prime or C if the number is composite.
18	1, 18, 2, 9, 3, 6	18, 36, 54…	C
7	1, 7	7, 14, 21, 28…	P

Students' lists of multiples will vary.

2 Mr. Smith's fourth graders made number posters like yours. Here is one of them.

2

Even though the big number at the top of the poster is covered, Sara says it has to be a composite number. Do you agree with Sara? Why or why not?

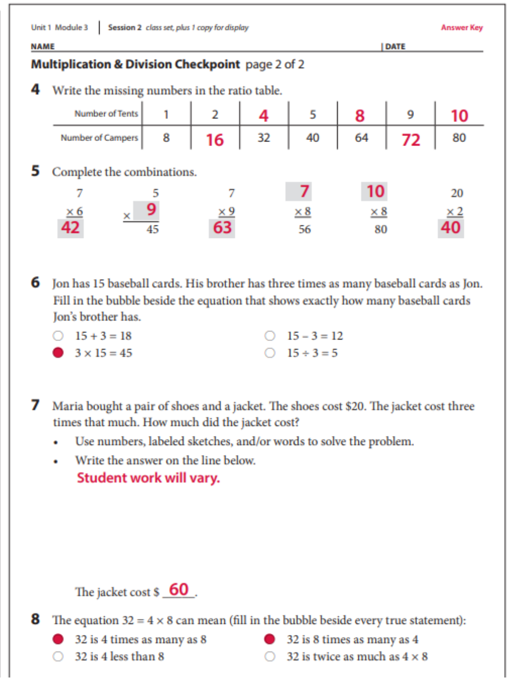
Sara is correct—all even numbers are composite.
Student explanations will vary.

3 Write the missing factor on the line provided.

6

7 | 42

(continued on next page)



Unit 1 Module 3 | Session 2 *class set, plus 1 copy for display* — Answer Key

NAME | DATE

Multiplication & Division Checkpoint page 2 of 2

4 Write the missing numbers in the ratio table.

Number of Tents	1	2	4	5	8	9	10
Number of Campers	8	16	32	40	64	72	80

5 Complete the combinations.

$7 \times 6 = 42$; $5 \times 9 = 45$; $7 \times 9 = 63$; $7 \times 8 = 56$; $10 \times 8 = 80$; $20 \times 2 = 40$

6 Jon has 15 baseball cards. His brother has three times as many baseball cards as Jon. Fill in the bubble beside the equation that shows exactly how many baseball cards Jon's brother has.

- ○ 15 + 3 = 18
- ○ 15 − 3 = 12
- ● 3 × 15 = 45
- ○ 15 ÷ 3 = 5

7 Maria bought a pair of shoes and a jacket. The shoes cost $20. The jacket cost three times that much. How much did the jacket cost?

- Use numbers, labeled sketches, and/or words to solve the problem.
- Write the answer on the line below.

Student work will vary.

The jacket cost $ 60.

8 The equation 32 = 4 × 8 can mean (fill in the bubble beside every true statement):

- ● 32 is 4 times as many as 8
- ● 32 is 8 times as many as 4
- ○ 32 is 4 less than 8
- ○ 32 is twice as much as 4 × 8

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 1 Addition and Subtraction Checkpoint
- Unit 1 Post-Assessment

NAME | DATE

Unit 1 Post-Assessment page 1 of 3

1 Complete the chart.

multiples may vary

	a List all factors of the number.	**b** List two multiples of the number.	**c** Write P if the number is prime or C if the number is composite.
11	1, 11	11, 22, 33, 44, 55...	P
24	1, 2, 3, 4, 6, 8, 12, 24	24, 48, 72, 96...	C

2 Write a prime number in the space below and tell how you know it is prime.

Answers will vary.
Example: 7 is a prime number.
It is prime because it has only two factors, itself and 1.

3 Write a composite number in the space below and tell how you know it is composite.

Answers will vary. Example: 6 is a composite number.
It is composite because it has factors other than itself and 1.
2 and 3 are also factors of 6.

4 The equation $9 \times 7 = 63$ can mean:

- ○ 9 folders and 7 folders together are 63 folders
- ○ 9 erasers divided into 7 groups is 63 erasers
- ● 63 crayons are 9 times the 7 crayons at the green table
- ○ The difference between 9 binders and 7 markers is 63

5 Fill in the bubbles beside the two equations that best represent this situation: Jalen picked 20 flowers. That is 4 times as many as his little brother, Andre, picked. How many flowers did Andre pick? (In the equations below, *f* stands for Andre's flowers.)

○ $20 \times 4 = f$ ● $20 = 4 \times f$ ● $20 \div f = 4$ ○ $20 - 4 = f$

6 Write and solve a multiplication equation for each of these problems.

a David is 12 years old. David's grandma is 5 times older than David. How old is David's grandma?

Work will vary.
$5 \times 12 = 60$; David's grandma is 60 years old.

(continued on next page)

NAME | DATE

Unit 1 Post-Assessment page 2 of 3

b Raven bought a dress and a sweater. The dress cost 2 times as much as the sweater. The sweater cost $19. How much did the dress cost?

Work will vary.
$2 \times 19 = 38$; The dress cost $38.

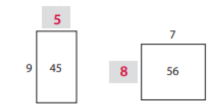
c Jorge bought a video game and a DVD. The video game cost $36. The DVD cost $9. How many times more than the DVD did the video game cost?

Work will vary.
$4 \times 9 = 36$ The game cost 4 times more than the DVD.

7 Fill in the blanks to complete this ratio table.

Number of Students	1	2	5	10	9
Number of Folders	8	16	40	80	72

8 Find and write in the missing dimension on each of the rectangles below.



9 Complete the equations.

a

$7 \times 7 = 49$ $5 \times 10 = 50$ $4 \times 9 = 36$ $7 \times 4 = 28$ $50 \times 2 = 100$ $3 \times 7 = 21$ $5 \times 8 = 40$

b $\underline{10} \times 8 = 80$ $30 \times 2 = \underline{60}$ $6 \times \underline{6} = 36$ $10 \times \underline{9} = 90$

(continued on next page)

NAME | DATE

Unit 1 Post-Assessment page 3 of 3

10 Solve each of the story problems below. Show your thinking with numbers, sketches, or words. Then, write an equation that represents your work, and record the answer, labeled with the correct units.

a There are 5 students in the purple group. They each brought 3 packs of paper to school. The class needs 8 times as much paper as the entire purple group brought to last the whole year. How many packs of paper does the class need?

Work will vary.

Equations will vary. Example:
$(3 \times 5) \times 8 = 120$
Equation

The class needs 120 packs of paper.
Answer, labeled with correct units

b Claire saw 4 columns of markers in a box of 36 markers. How many markers are in each column?

Work will vary.

Equations will vary. Example:
$36 \div 4 = 9$
Equation

There are 9 markers in each column.
Answer, labeled with correct units

11 The Hawks table group has 5 students, and each student brought 3 pencils. The Eagle table group has 5 students, and each student brought 5 pencils. After they collected the pencils, Mrs. Raptor divided them evenly among the students at those two tables. How many pencils did each student get?

a Solve the problem above. Show your thinking with numbers, sketches, or words. You do not need to write an equation for this problem.

Work will vary. Example:
$5 \times 3 = 15$ $5 \times 5 = 25$ $15 + 25 = 40$
There are 10 kids, so $40 \div 10 = 4$ pencils each.

b Which equation best represents this story problem? (The letter *p* stands for the number of pencils each student got.)

- ○ $5 + 3 + 5 + 5 = p$
- ● $((5 \times 3) + (5 \times 5)) \div 10 = p$
- ○ $(5 \times 3) + (5 \times 5) = p$
- ○ $((5 \times 3) + (5 \times 5)) \times 10 = p$

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 2: Multi-Digit Multiplication & Early Division
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

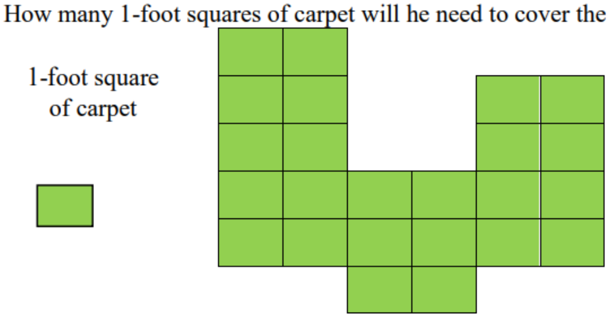
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
4.OA.3 Solve multi-step story problems involving only whole numbers, using addition, subtraction, multiplication, and division.
4.NBT.1 Demonstrate an understanding that in a multidigit number, each digit represents ten times what it represents in the place to its right.

4.NBT.5 Multiply a 2- or 3-digit whole number by a 1-digit whole number using strategies based on place value and the properties of operations.
4.NBT.5 Multiply two 2-digit numbers using strategies based on place value and the properties of operations.
4.NBT.5 Use equations or rectangular arrays to explain strategies for multiplying with multi-digit numbers.
4.NBT.6 Divide a 2-digit number by a 1-digit number, with a remainder, using strategies based on place value, the properties of operations, or the relationship between multiplication and division.
4.NBT.6 Use equations or rectangular arrays to explain strategies for dividing a multi-digit number by a 1-digit number.
4.MD.3 Apply the area formula for a rectangle to solve a problem.

Supporting Standards:
4.OA Solve single-step story problems involving division with remainders.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Solve multi-step story problems involving only whole numbers, using addition, subtraction, multiplication, and division.	1. The focus in this standard is to have students use and discuss various strategies.
2. Demonstrate an understanding that in a multidigit number, each digit represents ten times what it represents in the place to its right.	2. Students extend their understanding of place value related to multiplying and dividing by multiples of 10. *Example:* Recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.
3. Multiply a 2- or 3-digit whole number by a 1-digit whole number using strategies based on place value and the properties of operations. Multiply two 2-digit numbers using strategies based on place value and the properties of operations. Use equations or rectangular arrays to explain strategies	3. In this standard, students extend their understanding of multiplying a single digit factor times a multiple of ten to multiplying a single-digit factor times multi-digit factors. Students will also use area models, partial products, and properties of operations to solve multiplication problems.

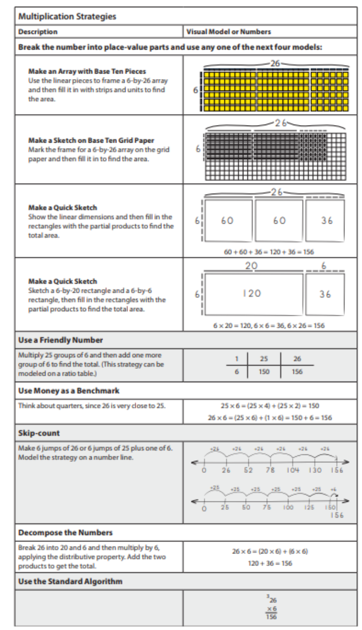
for multiplying with multi-digit numbers.	
4. Divide a 2-digit number by a 1-digit number, with a remainder, using strategies based on place value, the properties of operations, or the relationship between multiplication and division. Use equations or rectangular arrays to explain strategies for dividing a multi-digit number by a 1-digit number.	4. These standard calls for students to explore division through various strategies. Students should be able to apply their understanding of place value and various forms of a number to compute quotients. Students will also use arrays and area models, repeated subtraction, partial quotients, and properties of operations to solve division problems.
5. Apply the area formula for a rectangle to solve a problem.	Example: Mr. Rutherford is covering the miniature golf course with an artificial grass. How many 1-foot squares of carpet will he need to cover the entire course? 

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do place values relate to each other? 2. How can understanding place value help with multi-digit	1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. a. *Example: the 100's place is 10X larger than the 10's place.* 2. Generalizations are made about multiplying by 10, 100, and 1,000.

multiplication?

3. What models can be used to multiply multi-digit numbers?

3. A variety of multiplication model can be used to multiply larger numbers:
    a. Arrays, Quick Sketches, Ratio Tables, Partial Products.
    b. Example



Multiplication Strategies	
Description	**Visual Model or Numbers**
Break the number into place-value parts and use any one of the next four models:	
Make an Array with Base Ten Pieces Use the linear pieces to frame a 6-by-26 array and then fill it in with strips and units to find the area.	26; 6
Make a Sketch on Base Ten Grid Paper Mark the frame for a 6-by-26 array on the grid paper and then fill it in to find the area.	26; 6
Make a Quick Sketch Show the linear dimensions and then fill in the rectangles with the partial products to find the total area.	26; 6; 60, 60, 36; $60 + 60 + 36 = 120 + 36 = 156$
Make a Quick Sketch Sketch a 6-by-20 rectangle and a 6-by-6 rectangle, then fill in the rectangles with the partial products to find the total area.	20, 6; 6; 120, 36; $6 \times 20 = 120$, $6 \times 6 = 36$, $6 \times 26 = 156$
Use a Friendly Number	
Multiply 25 groups of 6 and then add one more group of 6 to find the total. (This strategy can be modeled on a ratio table.)	1 | 25 | 26 over 6 | 150 | 156
Use Money as a Benchmark	
Think about quarters, since 26 is very close to 25.	$25 \times 6 = (25 \times 4) + (25 \times 2) = 150$ $26 \times 6 = (25 \times 6) + (1 \times 6) = 150 + 6 = 156$
Skip-count	
Make 6 jumps of 26 or 6 jumps of 25 plus one of 6. Model the strategy on a number line.	+26, +26, +26, +26, +26, +26; 0, 26, 52, 78, 104, 130, 156 +25, +25, +25, +25, +25, +25, +6; 0, 25, 50, 75, 100, 125, 150, 156
Decompose the Numbers	
Break 26 into 20 and 6 and then multiply by 6, applying the distributive property. Add the two products to get the total.	$26 \times 6 = (20 \times 6) + (6 \times 6)$ $120 + 36 = 156$
Use the Standard Algorithm	
	$\begin{array}{r} {}^{3}26 \\ \times 6 \\ \hline 156 \end{array}$

4. How can place value strategies, properties of operations and/or the relationship between multiplication and division be used to find whole number quotients and remainders?

4. Understand relationships within the 12X12 multiplication chart.
    a. Doubles/halves; Doubles plus or minus 1; halves plus or minus 1; 10’s facts, half tens facts.

Resources

Student Technology Integration and Correspondence to ISTE Standards when Applicable:

Standard 1.5.C: Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Books / Media:

- Multiplication and Division Books
- Young Mathematicians at Work: Constructing Multiplication and Division
- Can You Count to a Googol?
- How Long or How Wide?
- On Beyond a Million
- Ten Times Better
- Sir Cumference and All the King's Tens
- Millions to Measure

Online Resources / Websites:

- Math Learning Center: Number Pieces App
- Math Learning Center: Partial Product Finder App
- Activity: Coloring Remainders in Pascal's Triangle
- Game: Bunny Times
- Game: Factris Game
- Game: Arithmetic Four
- Game: Drag Race Division
- App: Math Tappers: Multiples

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- **Area**: The total number of square units needed to cover a two-dimensional surface.
- **Area model of multiplication:** A model in which two numbers being multiplied are represented by the dimensions of a rectangle, and their product is represented by the area of the rectangle.

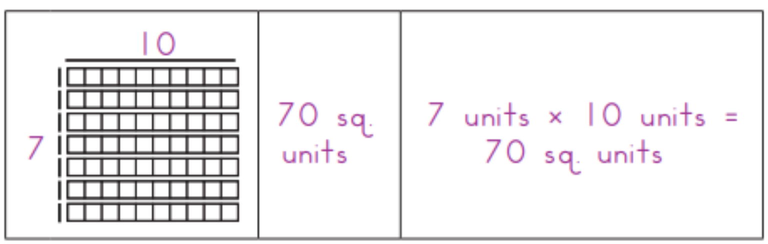
- **Array:** An arrangement consisting of equal rows and equal columns.
- **Associative property of multiplication:** A math rule that says that the way in which factors are grouped in a multiplication problem does not change the product.
- **Centimeter (cm):** A metric unit of length equal to 1⁄1 of a meter or about 2⁄5 of an inch.
- **Dimension:** The length, width, or height of a figure.
- **Divide:** To break or split into equal parts; to determine how many times one number goes into another.
- **Dividend:** A number to be divided by another number.
- **Divisor:** A number by which another number is to be divided.
- **Equation:** A mathematical statement asserting that two quantities have the same value.
- **Estimate:** To roughly calculate or judge the value, number, or quantity.
- **Factor:** A whole number that divides evenly into another number.
- **Gram (g):** A metric unit of mass equal to one-thousandth of a kilogram or about the weight of a standard paperclip.
- **Half:** Either of two equal or corresponding parts into which something is or can be divided.
- **Kilogram (kg):** A metric unit of mass equal to 1,000 grams or about 2.2 pounds.
- **Kilometer (km):** A metric unit of length equal to 1,000 meters (approximately 0.62 miles).
- **Liter (l):** A metric unit of capacity equal to 1,000 milliliters or about a quart.
- **Meter (m):** A metric unit of length equal to 100 centimeters or about 39 inches.
- **Milliliter (ml):** A metric unit of capacity equal to one-thousandth of a liter.
- **Multiple:** A number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3.
- **Multiply Pattern:** This pattern is created due to the commutative property of multiplication. The commutative property of multiplication states that when we multiply numbers in any order, we will get the same result.
- **Product:** The result of multiplying two or more numbers; in the array model, the product is the area of the array.
- **Quotient:** The result or answer in division; the number of times one quantity goes into another.
- **Ratio table:** A model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
- **Rectangle:**
- **Remainder:**
- **Unit:** Another name for 1 (the units' column is the same as the ones column); also, a standard amount in which attributes (length, duration, mass) can be measured and quantified.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

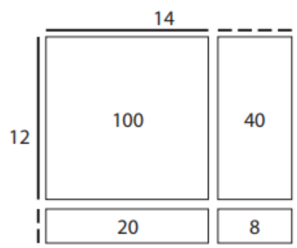
Students continue to build multiplicative reasoning as they work with multi-digit multiplication and early division. In week 1, students use base ten area pieces to investigate place value patterns, as well as model and solve single- and double-digit multiplication problems. In week 2, they move from building multiplication arrays to sketching them. They also build ratio tables and use them to generalize about the effects of multiplying by 10, 100, and 1,000. In the third week, students solve a variety of multiplication story problems, and work together to compile and compare the strategies they have been practicing. In week 4, students solve division problems that require them to make sense of remainders in a variety of contexts. New work places provide more practice with multiplication facts, multi-digit multiplication, and division with remainders.

Week 1, Building Multiplication Arrays: This module introduces multi-digit multiplication. To start, students build the Great Wall of Base Ten to examine the relationships among place values and to generalize about what happens when a number is multiplied by 10, 100, or 1,000. From there, students use base ten area pieces to model and solve single- and double-digit multiplication combinations. Their work with the 1-square-centimeter pieces reinforces the connection between multiplication and area.



Students multiply by 10, 100, and 1,000. Using the array helps them see, for example, that 8 × 10 = 80 or 8 tens. They also solve problems involving centimeters and meters, as well as dimes. These models illustrate the place value shifts that occur when multiplying by powers of 10.

Week 2, Arrays & Ratio Tables: This module focuses on multiplication arrays and moving students toward increasingly efficient strategies for solving multiplication problems. Students work with a variety of multiplication strategies, building on what they are learning in Module 1. Students move from building arrays with base ten area and linear pieces to sketching arrays on base ten grid paper to sketching open arrays. This transition is important as students deal with larger numbers in this unit and beyond. Students build their own ratio tables and use them to consider the effect of multiplying single digits by multiples of 10.



$$12 \times 14 = 168$$

$$\begin{aligned} 10 \times 10 &= 100 \\ 10 \times 2 &= 20 \\ 10 \times 4 &= 40 \\ 2 \times 4 &= 8 \\ 100 + 60 + 8 &= 168 \end{aligned}$$

$$\begin{array}{r} 12 \\ \times\ 14 \\ \hline 48 \\ +\ 120 \\ \hline 168 \end{array}$$

Students use the array to model multiplication of larger numbers. The array model makes visible the partial products that are an important part of the standard algorithm for multiplication and of many other multiplication strategies. Students will use this model for division as well.

Use a ratio table to find the product.

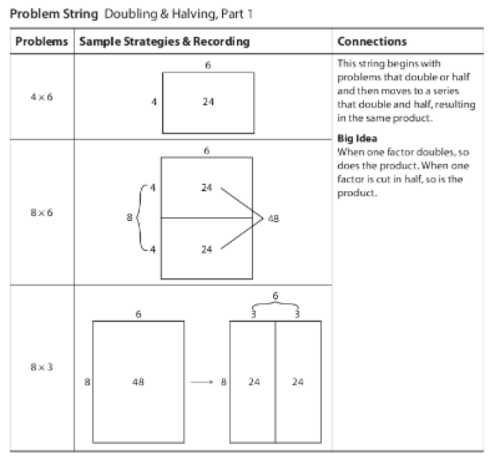
$32 \times 16 =$ 512

1	32
10	320
5	160
16	512

$$\begin{array}{r} 320 \\ 160 \\ +\ 32 \\ \hline 512 \end{array}$$

Students use ratio tables to solve multiplication problems. In the ratio table in this example, each number at left is multiplied by 32 to produce the number at right. Students working with the ratio table use what they know to calculate products they don't know. In this case, the student easily calculated both 10 × 32 and 5 × 32 (half of 320) and added the partial products (10 × 32, 5 × 32, and 1 × 32) to find the product of 16 and 32. Students will use ratio tables to divide multi-digit numbers as well.

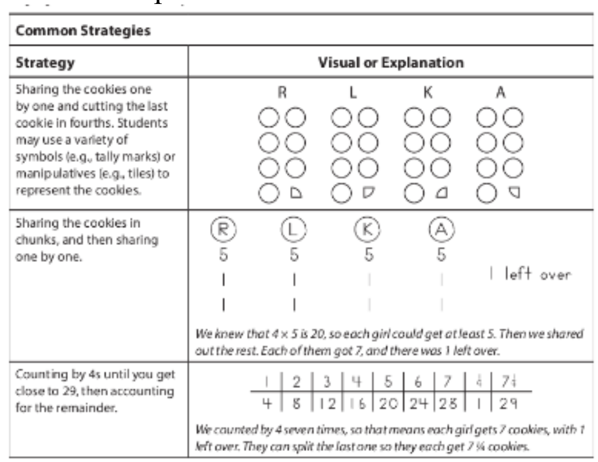
Week 3, Multiplication Stories & Strategies: Module 3 opens with a set of story problems followed by a math forum in which students have opportunities to share and extend their strategies for working with single- and double-digit multiplication as well as solving multi-step story problems. Students investigate the effect of doubling and halving factors in multiplication combinations. The use of coins and units of measure provides practice multiplying with landmark numbers, as well as practice converting from larger to smaller units of metric measure. The final session serves as a wrap-up, as students solve more story problems, and review and add to the class list of strategies for solving multi-digit multiplication problems.



Problem String Doubling & Halving, Part 1

Problems	Sample Strategies & Recording	Connections
4 × 6	6 4 24	This string begins with problems that double or half and then moves to a series that double and half, resulting in the same product. **Big Idea** When one factor doubles, so does the product. When one factor is cut in half, so is the product.
8 × 6	6 8 4 24, 4 24 → 48	
8 × 3	6 8 48 → 8 24 24 (3 3, 6)	

Week 4, Early Division with Remainders: Module 4 focuses on strategies for solving division problems with remainders, both in and out of context. Students begin by modeling division with remainders and solve story problems involving division with remainders. The class holds a math forum to discuss strategies for solving division problems and interpreting remainders based on context. At the end of the week, students take the unit post-assessment.



Common Strategies

Strategy	Visual or Explanation
Sharing the cookies one by one and cutting the last cookie in fourths. Students may use a variety of symbols (e.g., tally marks) or manipulatives (e.g., tiles) to represent the cookies.	R L K A
Sharing the cookies in chunks, and then sharing one by one.	R 5 | | L 5 | | K 5 | | A 5 | | ; | left over *We knew that 4 × 5 is 20, so each girl could get at least 5. Then we shared out the rest. Each of them got 7, and there was 1 left over.*
Counting by 4s until you get close to 29, then accounting for the remainder.	1 | 2 | 3 | 4 | 5 | 6 | 7 | ¼ | 7¼ / 4 | 8 | 12 | 16 | 20 | 24 | 28 | 1 | 29 *We counted by 4 seven times, so that means each girl gets 7 cookies, with 1 left over. They can split the last one so they each get 7 ¼ cookies.*

Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)
- By connecting the base ten pieces to positional notation for writing numbers, you are helping students reason quantitatively and abstractly about numbers into the ten-thousands. This helps students develop a stronger sense of these quantities and the relationships among them, which contributes to their understanding of place value and their ability to calculate fluently with large numbers.
- Students look for an express regularity in repeated reasoning when they solve a series of closely related problems like these. In solving problems, describing what they notice, and making connections among them, students develop a stronger sense of place value and an ability to multiply by powers of ten with fluency and understanding.
- The array model invites students to look for and make use of structure. The structures evident in the array-the 10 groups of 12-provide a visual justification for application of the associative property of multiplication.

Unit 2

How Long or How Wide?: A Measuring Guide (Math Is Categorical) by Brian P. Cleary

Ten Times Better by Richard Michelson

Sir Cumference and All the King's Tens: A Math Adventure by Cindy Neuschwande

Young Mathematicians at Work: Constructing Multiplication and Division by Catherine Twomey Fosnot, Maarten Dolk

Millions to Measure by David M. Schwartz, Steven Kellogg

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering

☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Challenge:

- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

Support:

- When applicable give students smaller numbers to practice the strategies
- When working with larger numbers, give students the addition/subtraction charts to support basic fact recall
- See "Game Variations" in work place guides
- See "Assessment and Differentiation" in work place teacher masters

ELL:

- Have pairs of ELL students observe another pair of students playing work places before playing it themselves.
- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 2 Pre-Assessment
- Multiplying by Tens Checkpoint

- Multiplication Checkpoint
- Work Places
- Home Connections
- Student Book Class Work

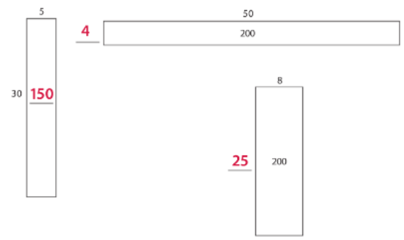
NAME | DATE

Unit 2 Pre-Assessment page 1 of 4

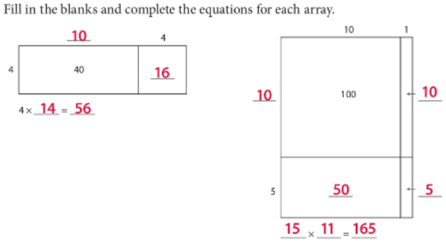
1 Pablo says there are 3 tens in 230. Hunter says there are 23 tens in 230. Their teacher says they're both right. How can that be so? Explain.

Student explanations will vary. Pablo's reasoning would be that there are 2 hundreds and 3 tens. Hunter is converting the 2 hundreds into 20 tens (for a total of 23).

2 Fill in the blanks.



3 Fill in the blanks and complete the equations for each array.



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NAME | DATE

Unit 2 Pre-Assessment page 2 of 4

4 Fill in the blanks in the ratio table.

Number of Folders	8	16	32	40	72	80	160
Number of Students	1	2	4	5	9	10	20

5 For each of the story problems a, b, and c, show your thinking with numbers, labeled sketches, or words. Then write an equation that represents the problem, and give the answer labeled with the correct units.

a Michelle saved 4 times as much money as her brother, Sam. He saved $40. How much money did Michelle save?

Work and equations will vary. Example:
$4 \times 40 = 4 \times (4 \times 10) = (4 \times 4) \times 10 = 16 \times 10 = 160$

Equation: **$4 \times 40 = 160$**
Answer, labeled with correct units: **Michelle saved $160**

b Kendra earns money washing windows. She makes 25 cents for each window she washes. If she washes 9 windows, how much money does she make?

Work and equations will vary. Example:
$9 \times 0.25 = (10 \times .25) - .25 = 2.50 - .25 = 2.25$

Equation: **$9 \times 0.25 = 2.25$**
Answer, labeled with correct units: **Kendra earned $2.25**

c One day, Kendra and her friend Amy washed windows together. They earned $25 and split it evenly. How much money did they each get?

Work and equations will vary. Example:
$25 \div 2 = (24 + 1) \div 2 = (24 \div 2) + (1.0 \div 2) = 12 + 0.5 = 12.5$

Equation: **$25 \div 2 = 12.50$**
Answer, labeled with correct units: **Each one got $12.50**

(continued on next page)

NAME | DATE

Unit 2 Pre-Assessment page 3 of 4

6 Carter also washes windows. He charges 10 cents for small windows and 25 cents for large windows.

a If Carter washes 13 small windows and 18 big windows, how much money does he make? Show all your work.

Work will vary. Example:
$(13 \times 0.10) + (18 \times 0.25) = 1.30 + 4.50 = 5.80$
Carter makes $5.80 washing windows.

b Which equation best represents this problem? (Note: m stands for the money Carter makes)

- ○ $10 + 25 + 13 + 18 = m$
- ● $(10 \times 13) + (25 \times 18) = m$
- ○ $(10 \times 25) + (13 \times 18) = m$
- ○ $(25 - 10) \times (18 - 13) = m$

7 Spencer has 270 marbles. Jake said, "Spencer has 3 times as many marbles as I do!" Which equation could represent this situation? (Note: j stands for Jake's marbles.)

○ $270 \times 3 = j$ ○ $3 \times 270 = j$ ● $3 \times j = 270$ ○ $270 \times j = 3$

8 Which of these numbers is prime?

● 17 ○ 21 ○ 27 ○ 34

9 Fill in the blanks.

12	100	50	20	30
× 16	× 4	× 5	× 6	× 4
192	400	250	120	120

(continued on next page)

NAME | DATE

Unit 2 Pre-Assessment page 4 of 4

10 True or False?

a $30 \times 9 = 9 \times (3 + 10)$ False

b $16 \times 18 = (16 \times 10) + (16 \times 8)$ True

c $3 \times 300 = (3 \times 3) \times 100$ True

d $21 \div 2 = 11$ R1 False

11 Fill in the blanks.

$15 \times 10 = (\underline{10} \times 10) + (5 \times 10)$ $(29 \times 30) = (20 \times 30) + (\underline{9} \times 30)$

12 Sara was cleaning her room. She found 17 tiny toy cars and decided to give them to her 2 brothers.

a Sara divided the 17 tiny toy cars evenly between the 2 boys. Which equation shows how things worked out?

● $17 \div 2 = 8$ R1 ○ $17 \div 2 = \$8.50$ ○ $17 \div 2 = 8\frac{1}{2}$

b Explain your choice. Why did you choose that equation instead of one of the other two?

The problem is not about money, so the middle equation is eliminated. A toy car can't really be divided in half, so the right equation is also eliminated. After dividing the cars into equal shares, there was one car left that neither boy received because that car would have made the shares unequal; this situation is represented by the equation on the left.

NAME | DATE

Multiplying by Tens & More Checkpoint

1 Mr. Brown has 14 girls and 10 boys in his class. Each girl brought 10 pencils. Each boy brought 13 pens.

a How many total pens and pencils does Mr. Brown's class have? Show your work using words, numbers, or labeled sketches.

Work will vary. Example:
$14 \times 10 = 140$
$10 \times 13 = 130$
$140 + 130 = 270$ pens and pencils in all

b Fill in the bubble beside the equation that best represents this problem (p stands for pens and pencils).

○ $14 + 10 + 10 + 13 = p$
● $(14 \times 10) + (10 \times 13) = p$
○ $(14 \times 10) - (10 \times 13) = p$
○ $(14 - 10) + (13 - 10) = p$

2 For the problem 14×10, which of the following statements is **not** correct:

● 14×10 is 14 add 0
○ 14×10 is 14 tens
○ 14×10 is 10 fourteens
○ 14×10 has to be more than 100 because $10 \times 10 = 100$

3 Fill in the blank.

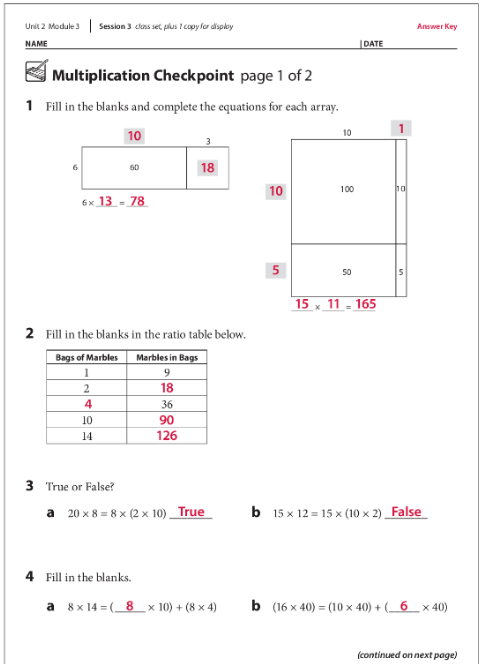
22	10	20	10	100	10	30
× 10	× 15	× 12	× 86	× 86	× 25	× 25
220	150	240	860	8,600	250	750

4 Fill in the blank.

$57 \times 20 = 57 \times 2 \times \underline{10}$ $23 \times 30 = \underline{23} \times 3 \times 10$

5 The area of a rectangle is 20. List all of its possible dimensions.

1×20, 2×10, 4×5



Unit 2 Module 3 | **Session 3** *class set, plus 1 copy for display* — **Answer Key**

NAME | DATE

Multiplication Checkpoint page 1 of 2

1 Fill in the blanks and complete the equations for each array.

10, 3; 6; 60, 18

6 × 13 = 78

10, 1; 10, 5; 100, 10; 50, 5

15 × 11 = 165

2 Fill in the blanks in the ratio table below.

Bags of Marbles	Marbles in Bags
1	9
2	18
4	36
10	90
14	126

3 True or False?

a $20 \times 8 = 8 \times (2 \times 10)$ True

b $15 \times 12 = 15 \times (10 \times 2)$ False

4 Fill in the blanks.

a $8 \times 14 = (8 \times 10) + (8 \times 4)$

b $(16 \times 40) = (10 \times 40) + (6 \times 40)$

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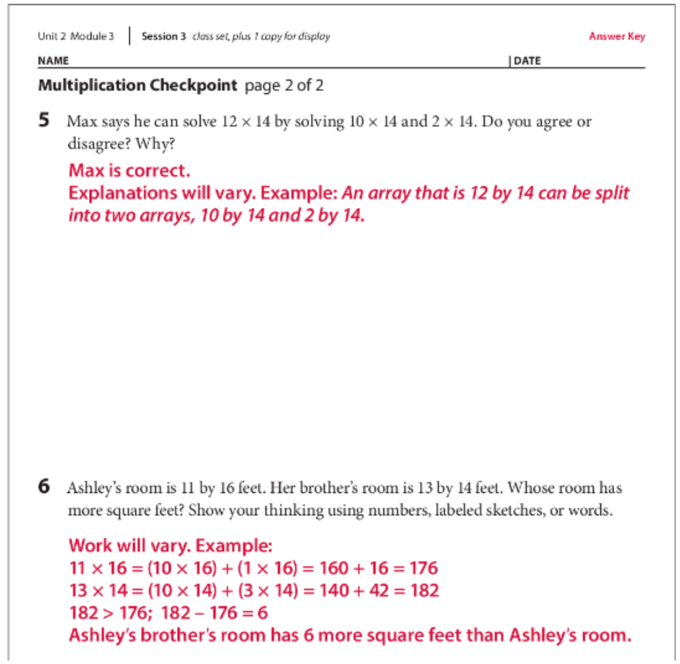


Unit 2 Module 3 | **Session 3** *class set, plus 1 copy for display* — **Answer Key**

NAME | DATE

Multiplication Checkpoint page 2 of 2

5 Max says he can solve 12 × 14 by solving 10 × 14 and 2 × 14. Do you agree or disagree? Why?

Max is correct.
Explanations will vary. Example: ***An array that is 12 by 14 can be split into two arrays, 10 by 14 and 2 by 14.***

6 Ashley's room is 11 by 16 feet. Her brother's room is 13 by 14 feet. Whose room has more square feet? Show your thinking using numbers, labeled sketches, or words.

Work will vary. Example:
$11 \times 16 = (10 \times 16) + (1 \times 16) = 160 + 16 = 176$
$13 \times 14 = (10 \times 14) + (3 \times 14) = 140 + 42 = 182$
$182 > 176$; $182 - 176 = 6$
Ashley's brother's room has 6 more square feet than Ashley's room.

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 2 Post-Assessment

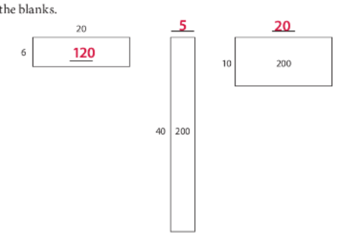
NAME | DATE

Unit 2 Post-Assessment page 1 of 4

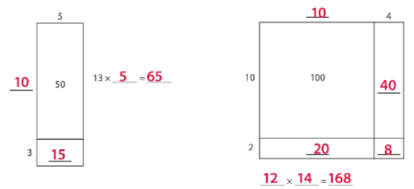
1 Maya says there are 4 hundreds in 5,467. Jenny says there are 54 hundreds in 5,467. Their teacher says they're both right. How can that be so? Explain.

Explanations will vary. Maya's reasoning would be that there are 5 thousands, 4 hundreds, 6 tens, and 7 ones in 5,467. Jenny is converting the 5 thousands into 50 hundreds (for a total of 54).

2 Fill in the blanks.



3 Fill in the blanks and complete the equations for each array.



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NAME | DATE

Unit 2 Post-Assessment page 2 of 4

4 Fill in the blanks in the ratio table.

Number of Pencils	13	**26**	39	**65**	**117**	130	**143**
Number of Students	1	2	**3**	5	9	**10**	11

5 For each of the story problems a, b, and c, show your thinking with numbers, labeled sketches, or words. Then write an equation that represents the problem and give the answer labeled with the correct units.

a Luke is six times as tall as his puppy, Farley. The puppy is 20 cm tall. How tall is Luke?

Work and equations will vary. Example:
$6 \times 20 = 6 \times (2 \times 10) = (6 \times 2) \times 10 = 12 \times 10 = 120$

Equation: **$6 \times 20 = 120$**
Answer, labeled with correct units: **120 cm**

b Maggie is building a new pen for her sheep. The pen is 19 by 11 feet. What is the area of the pen?

Work and equations will vary. Example:
$19 \times 11 = (19 \times 10) + (19 \times 1) = 190 + 19 = 209$

Equation: **$19 \times 11 = 209$**
Answer, labeled with correct units: **209 sq. ft.**

c Last Saturday Grandma brought 17 cookies for Lauren and her 3 cousins to share. The 4 children split the cookies evenly. How many did they each get?

Work and equations will vary. Example:
$17 \div 4 = (16 \div 4) + (1 \div 4) = 4 + \frac{1}{4} = 4\frac{1}{4}$

Equation: **$17 \div 4 = 4\frac{1}{4}$**
Answer, labeled with correct units: **$4\frac{1}{4}$ cookies (each)**

(continued on next page)

NAME | DATE

Unit 2 Post-Assessment page 3 of 4

6 Every fall, Maggie's family shears the wool from the sheep to spin it into yarn. Each sheep has about 8 pounds of wool. It takes about 4 pounds of wool to make a sweater.

a If Maggie has 6 sheep, how many sweaters can she make from her sheep's wool in one year? Show all your work.

Work will vary.
8×6 sheep = 48 pounds of wool
48 pounds of wool ÷ 4 pounds to make 1 sweater = 12 sweaters

b Which equation best represents this problem? (Note: *s* stands for the number of sweaters Maggie can make.)

- ● $(8 \times 6) \div 4 = s$
- ○ $(8 \times 6) \times 4 = s$
- ○ $(8 \times 4) \div 6 = s$
- ○ $(8 \times 4) \times 6 = s$

7 Justin has 180 toothpicks. Katie says, "Justin has four times as many toothpicks as I do!" Which equation could represent this situation? (Note: *k* stands for Katie's toothpicks.)

- ○ $4 \times 180 = k$
- ○ $180 \times 4 = k$
- ○ $180 \times k = 4$
- ● $4 \times k = 180$

8 Which of these numbers is composite?

○ 13 ○ 37 ● 25 ○ 11

9 Fill in the blanks.

$\begin{array}{r} 30 \\ \times\ 7 \\ \hline \mathbf{210} \end{array}$ $\begin{array}{r} 40 \\ \times\ \mathbf{4} \\ \hline 160 \end{array}$ $\begin{array}{r} \mathbf{29} \\ \times\ 10 \\ \hline 290 \end{array}$ $\begin{array}{r} 14 \\ \times\ 12 \\ \hline \mathbf{168} \end{array}$ $\begin{array}{r} 100 \\ \times\ \mathbf{9} \\ \hline 900 \end{array}$

(continued on next page)

NAME | DATE

Unit 2 Post-Assessment page 4 of 4

10 True or False?

a $70 \times 8 = 80 \times 7$ True

b $19 \times 13 = (10 \times 13) + (9 \times 13)$ True

c $5 \times 500 = (5 \times 5) + 100$ False

d $30 \div 4 = 7$ R2 True

11 Fill in the blanks.

$18 \times 10 = (\underline{10} \times 10) + (8 \times 10)$

$34 \times 20 = (30 \times 20) + (\underline{4} \times 20)$

12 Andre's dad made pancakes for breakfast the other day. He said that Andre and his 3 sisters could divide the 17 pancakes from the first batch equally among themselves.

a Which equation does NOT show how many pancakes each of the 4 children got?

○ $17 \div 4 = 4$ R1 ● $17 \div 4 = \$4.25$ ○ $17 \div 4 = 4\frac{1}{4}$

b Explain your choice. Why did you choose that equation instead of one of the other two?

The pancakes can be divided into equal shares of 4 and ¼ pancakes or into equal shares of 4 pancakes with one left over (perhaps for Andre's dad). The pancakes cannot be divided into money amounts, so the middle equation cannot be correct.

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 3: Fractions and Decimals
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. **Make sense of problems and persevere in solving them.**
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

4.NF.1 Use a visual model to explain why a fraction a/b is equivalent to a fraction (n × a)/(n × b).
4.NF.1 Use visual models to generate and recognize equivalent fractions.
4.NF.2 Compare two fractions with different numerators and different denominators, use the symbols >, =, and < to show those

comparisons, and explain why one fraction must be greater than or less than another.
4.NF.3a Explain addition of fractions as joining parts referring to the same whole.
4.NF.3b Express a fraction as the sum of other fractions with the same denominator in more than one way and write equations to match.
4.NF.3c Add and subtract fractions.
4.NF.3d Solve story problems involving addition or subtraction of fractions referring to the same whole and with like denominators.
4.NF.4a Demonstrate an understanding that a fraction a/b is a multiple of the unit fraction 1/b; write an equation showing that a fraction a/b is the product of a × 1/b.
4.NF.4b Multiply a fraction by a whole number; demonstrate an understanding that any multiple of a/b is also a multiple of the unit fraction 1/b.
4.NF.5 Express a fraction with denominator 10 as an equivalent fraction with denominator 100.
4.NF.5 Add a fraction with denominator 10 to a fraction with denominator 100 by rewriting the first fraction as an equivalent fraction with denominator 100.
4.NF.6 Write fractions with denominators 10 and 100 in decimal notation.
4.NF.7 Compare two decimal numbers with digits to the hundredths place, use the symbols >, =, and < to show those comparisons, and explain why one decimal number must be greater than or less than another.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Recognize and generate equivalent fractions using visual fraction models.	1. Fractions that represent the same part of the whole are equivalent.
2. Compare two fractions with the denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100 and use the benchmark fractions 0, ½ and 1 whole to compare fractions.	2. Different numerators and denominators determine size.
3. Solve addition and subtraction problems with	3. Addition and subtraction of fractions as joining and separating parts referring to the same whole, including

denominators of 2, 3, 4, 5, 6, 8, 10, 12, and 100.	mixed numbers and improper fractions.
4. Multiply a whole number by a unit fraction, using this understanding to multiply a whole number by any fraction less than one.	4. This standard calls for students to understand a fraction as a whole number of groups of a unit fractions.
5. Students make connections and compare fractions with denominators of 10 and 100 and decimals of the same value.	5. The connection that a fraction that has been equally partitioned into 10 or 100 equal parts (10th and 100ths) can also be written as a decimal.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can the same fractional amounts be renamed using equivalent fractions?	1. Explain why a fraction a/b is equivalent to a fraction (n x a)/ (n x b) by using visual fraction models.
2. How can fractions be compared and ordered?	2. Compare two fractions with different numerators and different denominators by creating common denominators or numerators or using models, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole.
3. What does it mean to add and subtract fractions and mixed numbers?	3. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole and decomposing a fraction into a sum of fractions with the same denominator in more than one way.
4. How can understanding multiplication be helpful in multiplying fractions by whole numbers?	4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. (*i.e., repeated addition, skip counting)*

5. What is the relationship between fractions and decimals?	5. Use decimal notation for fractions with denominators 10 or 100. *(i.e. Rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.)*

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Informational Texts:
• **Informational Books:**
  ○ Amazon Book List
  ○ Young Mathematicians at Work
• **Media: Games**
  ○ Concentration
  ○ Dirt Bike Comparing Fractions
  ○ Feed Me Fractions
  ○ Estimate Fractions
  ○ MathTappers: Equivalents
  ○ Pecking Order
• **Apps:**
  ○ MLC Fraction App
  ○ MLC Money Pieces App
  ○ MLC Number Frames App
  ○ MLC Number Line App
  ○ MLC GeoBoard App
 	
Online Resources / Websites:
• Egg Carton MLC Blog

- Zoomable Number Line
- Connecting Fractions and Decimals with a 10X10 grid MLC Blog

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

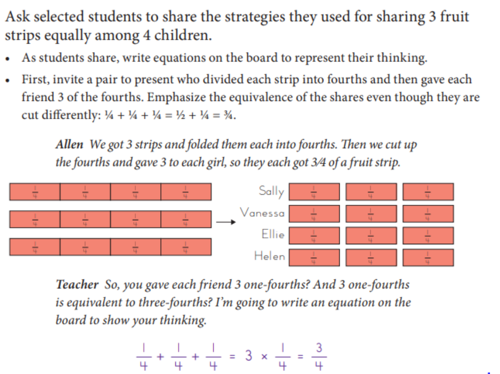
Area: the total number of square units needed to cover a two-dimensional surface.
Decimal: relating to powers of 10; also, a fraction with a denominator that is a power of 10, often expressed using digits and a decimal point.
Denominator: the bottom number in a fraction, which shows into how many equal parts the whole is divided; also, the divisor.
Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number.
Divide: to break or split into equal parts; to determine how many times one number goes into another.
Equal: of the same amount or value.
Equation: a mathematical statement asserting that two quantities have the same value.
Equivalent Fraction: two or more different fractions that represent the same quantity.
Fraction: a number expressed as some number of equal parts of a whole.
Hundredth: one of 100 equal parts of a whole (1⁄100 or 0.01).
Improper Fraction: a fraction greater than 1 that is not expressed as a mixed number; a fraction in which the numerator is larger than the denominator.
Mixed Number: a number greater than 1 expressed as a whole number plus a fraction whose value is less than 1.
Numerator: the top number in a fraction, which shows how many equal parts are to be counted; also, the dividend.
Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement.
Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array.
Quotient: the result or answer in division; the number of times one quantity goes into another.
Ratio Table: a model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
Sum/ Total: the result of adding two or more numbers.
Tenth: 1 of 10 equal parts of a whole (1⁄10 or 0.1).
Unit: another name for 1 (the unit's column is the same as the ones column); also, a standard amount in which attributes (length, duration, mass) can be measured and quantified.

Learning Plan

In this unit, students work with a variety of tools, including folded paper strips, egg cartons, geoboards, number lines, and base ten pieces, to model, read, write, compare, order, compose, and decompose fractions and decimals. Their investigations and explorations range from the purely mathematical—the relationship between fifths and decimals, for example—to applied, as they determine a strategy to figure out how many candy bars the fourth-grade teacher will have to buy if she plans to give an undefined number of students three-quarters of a bar each.

Learning Tasks Per Week (Including Instructional Strategies)

Week One: In this module, students review fraction skills and concepts from the previous grade and extend their understandings to mixed numbers, improper fractions, and more sophisticated strategies for generating equivalent fractions. They begin by exploring a fair-sharing situation in which the idea of fractions as quotients is developed. Then they fold and cut paper strips to model and investigate the relationship between mixed numbers and improper fractions. During the last two sessions in the module, students' model and investigate equivalent fractions in a very different context—eggs in a carton.

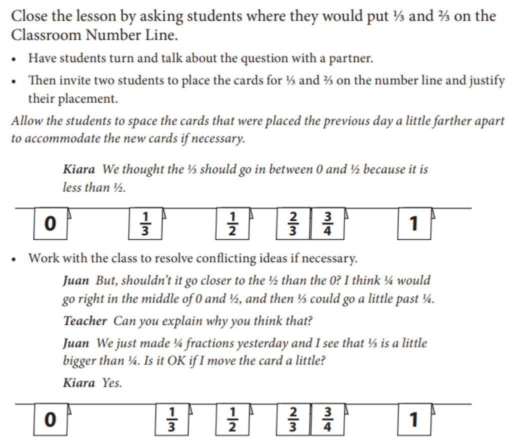

Ask selected students to share the strategies they used for sharing 3 fruit strips equally among 4 children.

- As students share, write equations on the board to represent their thinking.
- First, invite a pair to present who divided each strip into fourths and then gave each friend 3 of the fourths. Emphasize the equivalence of the shares even though they are cut differently: ¼ + ¼ + ¼ = ½ + ¼ = ¾.

Allen *We got 3 strips and folded them each into fourths. Then we cut up the fourths and gave 3 to each girl, so they each got 3⁄4 of a fruit strip.*

Teacher *So, you gave each friend 3 one-fourths? And 3 one-fourths is equivalent to three-fourths? I'm going to write an equation on the board to show your thinking.*

$$\frac{1}{4} + \frac{1}{4} + \frac{1}{4} = 3 \times \frac{1}{4} = \frac{3}{4}$$


Close the lesson by asking students where they would put ⅓ and ⅔ on the Classroom Number Line.

- Have students turn and talk about the question with a partner.
- Then invite two students to place the cards for ⅓ and ⅔ on the number line and justify their placement.

Allow the students to space the cards that were placed the previous day a little farther apart to accommodate the new cards if necessary.

Kiara *We thought the ⅓ should go in between 0 and ½ because it is less than ½.*

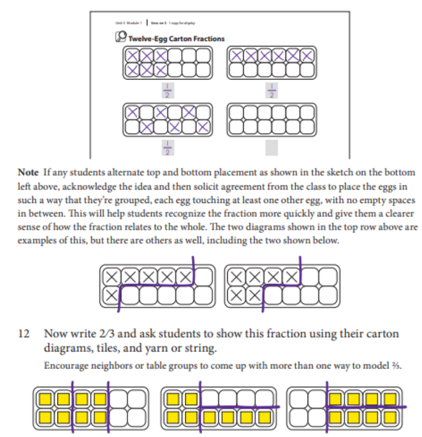
- Work with the class to resolve conflicting ideas if necessary.

Juan *But, shouldn't it go closer to the ½ than the 0? I think ¼ would go right in the middle of 0 and ½, and then ⅓ could go a little past ¼.*

Teacher *Can you explain why you think that?*

Juan *We just made ¼ fractions yesterday and I see that ⅓ is a little bigger than ¼. Is it OK if I move the card a little?*

Kiara *Yes.*

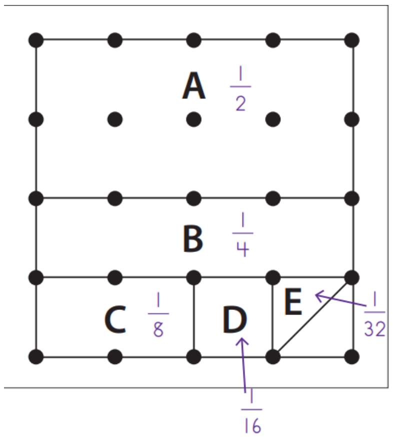


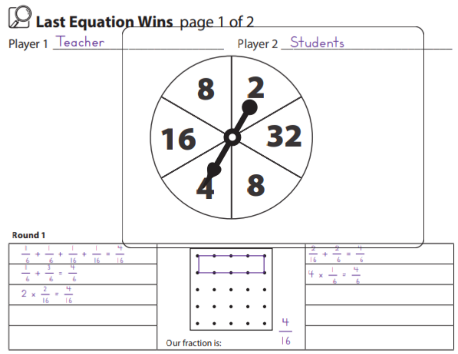
Note If any students alternate top and bottom placement as shown in the sketch on the bottom left above, acknowledge the idea and then solicit agreement from the class to place the eggs in such a way that they're grouped, each egg touching at least one other egg, with no empty spaces in between. This will help students recognize the fraction more quickly and give them a clearer sense of how the fraction relates to the whole. The two diagrams shown in the top row above are examples of this, but there are others as well, including the two shown below.

12 Now write 2⁄3 and ask students to show this fraction using their carton diagrams, tiles, and yarn or string.

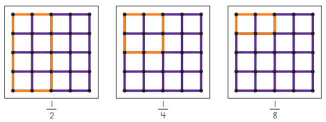
Encourage neighbors or table groups to come up with more than one way to model ⅔.

Week Two: In this module, the geoboard is assigned a value of 1. Students name fractional parts of the geoboard and describe the parts' relationships to one another. Their observations are then extended into comparing fractions with unlike numerators and denominators and adding fractions with like denominators. The last three sessions in the module feature an extended problem-solving opportunity followed by a math forum, as well as two new Work Places that provide practice with composing and decomposing fractions.

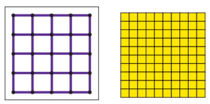


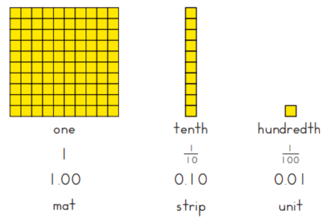


Week Three: In this module, the base ten mat is assigned a value of 1. Students determine that the strip and the unit are worth 1/10 and 1/100 respectively and are introduced to the decimal notation for these fractions. The base ten pieces serve as a visual anchor as students compare decimal numbers and investigate the relationship between tenths and hundredths. During the last two sessions, the teacher introduces two new Work Places to provide practice with adding tenths and hundredths, as well as building and comparing fractions. There is a checkpoint on fractions and decimals at the end of the module.

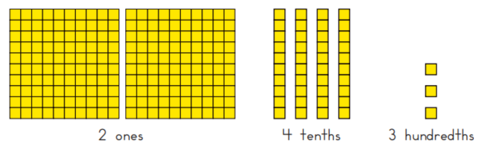


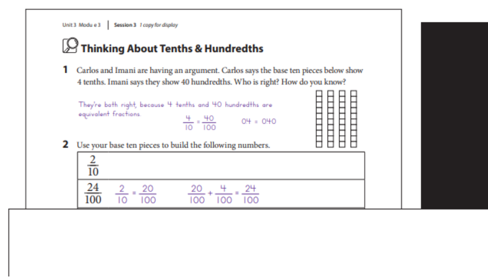
Now display the geoboard divided into sixteenths and the one of your ten mats side-by-side. Ask students to think silently and then talk in p about how these models are similar and how they are different.





Now, display a collection of 2 mats, 4 strips, and 3 units and label it while students build the same collection.




Unit 3 Module 3 | Session 3 1 copy for display

Thinking About Tenths & Hundredths

1 Carlos and Imani are having an argument. Carlos says the base ten pieces below show 4 tenths. Imani says they show 40 hundredths. Who is right? How do you know?

They're both right, because 4 tenths and 40 hundredths are equivalent fractions.

$\frac{4}{10} = \frac{40}{100}$ 0.4 = 0.40

2 Use your base ten pieces to build the following numbers.

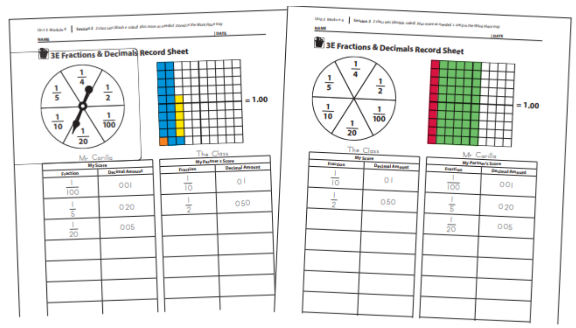
$\frac{2}{10}$	
$\frac{24}{100}$	$\frac{2}{10} = \frac{20}{100}$ $\frac{20}{100} + \frac{4}{100} = \frac{24}{100}$

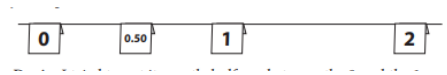
Week Four: The activities in this module, including another new Work Place, reinforce the relationship between decimals and fractions with denominators 10 and 100. Students are also invited to investigate the connection between decimals and other common fractions, including halves, fourths, fifths, and twentieths. The module concludes with a unit post-assessment.

$$\frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10} = \frac{2}{5}$$

$$4 \times \frac{1}{10} = \frac{2}{5}$$

$$2 \times \frac{1}{5} = \frac{2}{5}$$





Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to “Literature Connections” in Resources.)
    - **Unit 3** Young Mathematicians at Work: Constructing Fractions, Decimals, and Percents by Catherine Twomey Fosnot, Maarten Dolk.
- As students solve these related problems, they begin to look for and make use of regularity in repeated reasoning. This opportunity to notice relationships, and to solve related problems in different contexts, deepens students’ understanding of fractions.
- While most models for fractions portray them as either parts of a whole or parts of a set, the egg carton can be used to model fractions in both ways. When placed in a 12-egg carton, 8 tiles represent 8 out of a set of 12 eggs or 8/12.
- In modeling the different fractions on the egg cartons, and when making observations about the collection of fractions, students look for and make use of structures in the carton model. This deepens their understanding of, and flexibility in representing, fractions.
- Asking students to describe patterns they notice on the chart invites them to look for and express regularity in repeated reasoning. In their search for regularity, students will make observations related to equivalent fractions and adding fractions with like denominators.
- The base ten pieces are a powerful model for decimal numbers. By using them to model different numbers and justify

comparisons of those numbers, students are developing a deep understanding of decimal numbers and our base ten number system.

Westbrook Public Schools' Portrait of a Graduate **Learning Expectations**
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving ☒ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Differentiation
Challenge: ● Ask students to create their own version of a work place and teach another pair of students how to play ● See "Game Variations" in work place guides ● See "Assessment and Differentiation" in work place teacher masters
Support: ● When applicable give students smaller numbers to practice the strategies ● When working with larger numbers, give students the addition/subtraction charts to support basic fact recall. ● See "Game Variations" in work place guides ● See "Assessment and Differentiation" in work place teacher masters
ELL: ● Have pairs of ELL students observe another pair of students playing work places before playing it themselves.

- Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play.
- Make visual word resource cards available to students who need extra language support.
- Give students visual word cards for non-academic vocabulary as necessary.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Pre-Assessment
- Equivalent Fractions Checkpoint
- Fractions and Decimals Checkpoint
- Work Places
- Home Connections
- Student Book Class Work

Unit 3 Pre-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name														
1a Writes 3 fractions to represent a geoboard with 8 out of 16 squares shaded in. *[1/2, 4/8, 8/16; 2/4 acceptable but not expected]*	4.NF.1	**3 pts.**															
1b Writes 3 fractions to represent an egg carton with 8 eggs out of 12 shaded in. *[2/3, 4/6, 8/12]*	4.NF.1	**3 pts.**															
1c Writes 3 fractions to represent a grid of 100 with 50 squares shaded in. *Acceptable answers include 50/100, 5/10, 1/2, 2/4.*	4.NF.1	**3 pts.**															
2a Recognizes that 5/6 is the sum of 5 of the unit fraction 1/6. *Yes*	4.NF.3a	**1 pt.**															
2b Writes equations to show 5/6 as the sum of other fractions with the same denominator in more than one way. *Responses will vary. Acceptable responses include 1/6 + 4/6, 2/6 + 3/6, 3/6 + 1/6 + 1/6, 5 × 1/6.*	4.NF.3b	**3 pts.** • 1 pt. for each accurate equation															
3a Recognizes that 4/6 and 8/12 of the same sized pie are equivalent. *[Lori is right.]*	4.NF.1	**1 pt.**															
3b Uses labeled sketches (visual models) to explain why 4/6 is equal to 8/12. *Work will vary.*	4.NF.1	**1 pt.** for a viable explanation that includes the use of labeled sketches															
4a Recognizes that half a large pizza is not the same as half a smaller pizza. *[no]*	4.NF.2	**1 pt.**															
4b Demonstrates an understanding that a comparison of fractions is valid only when they refer to the same whole. *Responses will vary.*	4.NF.2	**1 pt.** for any viable explanation															
5a Demonstrates the understanding that 4/10 = 40/100, using a visual model. *[They're both right.]*	4.NF.5	**1 pt.**															
5b Explains why 4/10 and 40/100 are equivalent fractions. *Responses will vary. Example: Each tenth has 10 hundreds, so 4 tenths is the same as 40 hundredths.*	4.NF.5	**1 pt.** for any viable explanation															
6a–d Compares two fractions with different numerators and different denominators. *[T, T, F, F]*	4.NF.2	**4 pts.**															
7a–d Compares two decimals with digits to the hundredths place. *[<, <, >, =]*	4.NF.7	**4 pts.**															
		Subtotal page 1															

Bridges in Mathematics Grade 4 Assessment Guide

Unit 3 Pre-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name														
8a–d Writes fractions with denominator 10 or 100 in decimal notation. *a) .34 or 0.34 b) .2 or 0.2 c) .8 or 0.8 d) .73 or 0.73*	4.NF.6	**4 pts.**															
9a Compares two fractions with different numerators and different denominators. *[The red ribbon is longer.]*	4.NF.2	**1 pt.**															
9b Explains why 2/3 is greater than 7/12. *Explanations will vary. Example: 2/3 is the same as 8/12, and 8/12 is more than 7/12.*	4.NF.2	**1 pt.** for any viable explanation															
10a–d Adds and subtracts fractions and mixed numbers with like denominators. Also adds tenths and hundredths. *a) 84/100 b) 9 6/12 or 9 3/6 or 9 1/2 c) 3/8 d) 3 2/10 or 3 1/5*	4.NF.3c 4.NF.5	**4 pts.**															
11a Compares two fractions, one with denominator 10 and the other with denominator 100. *[Elisa ran farther.]*	4.NF.2	**1 pt.**															
11b Explains why 87/100 is greater than 8/10. *Responses will vary. Example: 8/10 = 80/100, which is less than 87/100*	4.NF.2	**1 pt.** for any viable explanation															
11c Adds a fraction with denominator 10 to a fraction with denominator 100. *87/100 or 0.87 or .87 mile; work will vary.*	4.NF.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)															
12a Solves story problems that involve adding fractions with like denominators. *2 1/2 pounds; work will vary.*	4.NF.4c	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)															
12b Solves story problems that involve subtracting fractions with like denominators. *1 1/2 pounds; work will vary.*	4.NF.3d	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)															
13a Solves story problems that involve adding mixed numbers with like denominators. *7 5/8 feet of butcher paper; work will vary.*	4.NF.3d	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)															
13b Compares two fractions in a story problem context. *Yes, it's enough; explanations will vary. Example: 7 5/8 feet > 7 2/8 feet—he has 3/8 feet extra.*	4.NF.2	**2 pts.** • 1 pt. for correct answer • 1 pt. for a viable explanation															
		Subtotal page 2															
		Subtotal from page 1															
TOTAL SCORE/LEVEL OF PROFICIENCY*		**49 pts.**															

13–49 points (25%–100%): Working at Tier 1 or Tier 2 Level **12 points or fewer (24% or less):** May need Tier 3 support to succeed with the work in Unit 3

Note When considering strategy use, award the point if the strategy used could lead to a correct answer, even if the student made a mathematical error.

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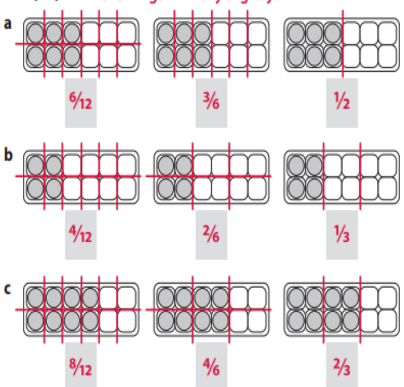
Bridges Unit Assessments | Unit 3 1 copy for every 15 students

Unit 3 Module 2 | **Session 1** *class set, plus 1 copy for display* — Answer Key

NAME | DATE

Equivalent Fractions Checkpoint

1 Write three equivalent fractions to show what part of the egg cartons in each row is filled. Draw lines on the egg cartons in each row to show how you divided them into equal parts. **Drawings will vary slightly.**

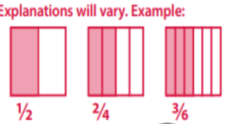


2 LaTonya says that $\frac{1}{2}$, $\frac{2}{4}$, and $\frac{3}{6}$ can all be worth the same amount.

a Do you agree with her? **Yes**

b Use labeled sketches to explain your thinking.

Explanations will vary. Example:



Unit 3 Module 2 | **Session 4** *class set, plus 1 copy for display*

NAME | DATE

Unit 3 Work Place Log

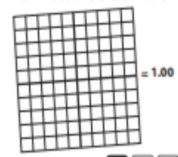
3A Dozens of Eggs

3B Racing Fractions

3C Decimal Four Spins to Win

3D Decimal More or Less

3E Fractions & Decimals



Personal Practice

Computer Activity

Work with the Teacher

Fraction & Decimal Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name														
1a Adds fractions with like denominators to solve a story problem. *[illegible] of the cake*	4.NF.3d	**1 pt.**															
1b Add fractions with like denominators solve a story problem. Uses two equivalent fractions to show the answer. *[illegible] of the cake*	4.NF.1 4.NF.3d	**2 pts.** 1 pt. for each correct fraction															
1c Adds and subtracts fractions with like denominators to solve a story problem. *[illegible] of the cake*	4.NF.3d	**1 pt.**															
1d Subtracts fractions with like denominators to solve a story problem. Uses two equivalent fractions to show the answer. *[illegible] of the cake*	4.NF.3d	**2 pts.** 1 pt. for each correct fraction															
2a–c Compares fractions and explains who got more by reasoning about fractions. *Simon got more pizza; [illegible]; explanations will vary.*	4.NF.2	**3 pts.** • 1 pt. for correct answer • 1 pt. for correct comparison • 1 pt. for a viable justification															
3 Identifies the fraction of a geoboard (assigned an area of 1 square unit) that has been shaded in. [illegible]	4.NF.1	**1 pt.**															
4 Writes equivalent decimals and fractions to describe a model. *[illegible], 0.3, 0.30*	4.NF.5 4.NF.6	**4 pts.** • 1 pt. for each correct decimal or fraction name															
5a–b Compares decimals to the hundredths place. *a) 0.70 > 0.07 b) 0.35 < 3.5*	4.NF.7	**2 pts.** • 1 pt. for each correct answer															
TOTAL SCORE/LEVEL OF PROFICIENCY*		**16 pts.**															

* **Meeting Standard** 12–16 points (75%–100% correct) **Approaching Standard** 8–11 points (50–74% correct) **Strategic** 4–7 points (25–49% correct) **Intensive** 3 points or less (24% or less correct)

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 3 Post Assessment

Unit 3 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Writes 3 fractions to represent an egg carton with 4 eggs out of 12 shaded in. *[1/3, 2/6, 4/12]*	4.NF.1	**3 pts.**	
1b Writes 3 fractions to represent a geoboard with 8 out of 16 squares shaded in. *[1/2, 4/8, 8/16]*	4.NF.1	**3 pts.**	
1c Writes 3 fractions to represent a grid of 100 with 70 squares shaded in. *[Any three of: 7/10, 35/50, 70/100, 14/20]*	4.NF.1	**3 pts.**	
2a Recognizes that 1 5/6 is the sum of 4/6 + 7/6. *[Yes]*	4.NF.3a	**1 pt.**	
2b Writes equations to show 1 5/6 as the sum of other fractions with the same denominator in more than one way. *Responses will vary. Acceptable responses include 5/6 + 6/6, 10/6 + 1/6, 4/6 + 7/6, 1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 6/6, 11 × 1/6, and so on.*	4.NF.3b	**3 pts.** • 1 pt. for each accurate equation	
3a Recognizes that 2/6 and 4/12 of the same sized pan of cornbread are equivalent. *[Jon is right.]*	4.NF.1	**1 pt.**	
3b Uses labeled sketches (visual models) to explain why 2/6 is equal to 4/12. *Work will vary.*	4.NF.1	**1 pt.** for a viable explanation that includes the use of labeled sketches	
4a Recognizes that half a mini-pizza is not (necessarily) more than 1/4 of a giant pizza. *[No]*	4.NF.2	**1 pt.**	
4b Demonstrates an understanding that a comparison of fractions is valid only when they refer to the same whole. *Responses will vary.*	4.NF.2	**1 pt.** for any viable explanation	
5a Demonstrates the understanding that 2/10 = 20/100, using a visual model. *[They're both right.]*	4.NF.5	**1 pt.**	
5b Explains why 2/10 and 20/100 are equivalent fractions. *Responses will vary.*	4.NF.5	**1 pt.** for any viable explanation	
6a–d Compares two fractions with different numerators and different denominators. *[F, T, T, F]*	4.NF.2	**4 pts.**	
7a–d Compares two decimals with digits to the hundredths place. *[=, <, =, >]*	4.NF.7	**4 pts.**	
Subtotal page 1			

Unit 3 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
8a–d Writes fractions with denominator 10 or 100 in decimal notation. *a) .29 or 0.29 b) .9 or 0.9 c) .75 or 0.75 d) .02 or 0.02*	4.NF.6	**4 pts.**	
9a Compares two fractions with different numerators and different denominators. *[The orange embroidery thread is longer.]*	4.NF.2	**1 pt.**	
9b Explains why 3/4 is greater than 5/8. *Explanations will vary. Example: 3/4 = 9/12 and 5/6 = 10/12, so 5/6 > 3/4.*	4.NF.2	**1 pt.** for any viable explanation	
10a–d Adds and subtracts fractions and mixed numbers with like denominators. Also adds tenths and hundredths. *a) 88/100 b) 7 3/5 c) 4/6 or 2/3 d) 53/100*	4.NF.3c 4.NF.5	**4 pts.**	
11a Compares two fractions, one with denominator 10 and the other with denominator 100. *[Natasha ran farther.]*	4.NF.2	**1 pt.**	
11b Explains why 4/10 is greater than 25/100. *Responses will vary. Example: 4/10 = 40/100, which is more than 25/100.*	4.NF.2	**1 pt.** for any viable explanation	
11c Adds a fraction with denominator 10 to a fraction with denominator 100. *65/100 or 0.65 or .65 mile; work will vary.*	4.NF.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)	
12a Solves story problems that involve multiplying a fraction by a whole number. *18/5 or 3 3/5 pounds; work will vary.*	4.NF.4c	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)	
12b Solves story problems that involve subtracting fractions with like denominators. *1 2/5 pounds; work will vary.*	4.NF.3d	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)	
13a Solves story problems that involve adding mixed numbers with like denominators. *6 gallons; work will vary.*	4.NF.3d	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)	
13b Solves story problems that involve subtracting mixed numbers with like denominators. *Yes, they had 3/4 of a gallon left over; work will vary.*	4.NF.2	**2 pts.** • 1 pt. for correct answer • 1 pt. for strategy (see note)	
Subtotal page 2			
Subtotal from page 1			
TOTAL SCORE/LEVEL OF PROFICIENCY*		**49 pts.**	

* **Meeting Standard** 37–49 points (75%–100% correct) **Approaching Standard** 25–36 points (50–74% correct) **Strategic** 13–24 points (25–49% correct) **Intensive** 12 points or less (24% or less correct)

Note When considering strategy use, award the point if the strategy used could lead to a correct answer, even if the student made a mathematical error.

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 4: Addition, Subtraction & Measurement
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
4.OA.3 Solve multi-step story problems involving only whole numbers using addition, subtraction, multiplication, and division.
4.NBT.1 Demonstrate an understanding that in a multidigit number, each digit represents ten times what it represents in the place to its right.

4.NBT.2 Read and write multi-digit whole numbers represented with base-ten numerals, number names, and expanded form; compare pairs of multi-digit numbers; use >, =, and < symbols to record comparisons. **4.NBT.3** Round multi-digit whole numbers to the nearest hundred, thousand, and ten thousand. **4.NBT.4** Use the standard algorithm with fluency to add and subtract multi-digit whole numbers. **4.MD.1** Identify the relative sizes of centimeters, meters, and kilometers; grams and kilograms; ounces and pounds; milliliters and liters; seconds, minutes, and hours. **4.MD.1** Express a measurement in a larger unit in terms of a smaller unit within the same system of measurement. **4.MD.1** Record equivalent measurements in different units from the same system of measurement using a 2-column table. **4.MD.2** Solve story problems involving distance, time, liquid volume and mass using addition, subtraction, multiplication, and division of whole numbers. **4.MD.2** Solve story problems that involve expressing measurements given in a larger unit in terms of a smaller unit within the same system of measurement; use diagrams to represent measurement quantities. **Supporting Standards:** **4.NBT** Fluently add and subtract multi-digit whole numbers, using an algorithm or another strategy.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	**Concepts** *What must students* ***know****?*
1. Solve multi-step story problems involving only whole numbers, using addition, subtraction, multiplication, and division.	1. The focus in this standard is to have students use and discuss various strategies.
2. Demonstrate an understanding that in a multidigit number, each digit represents ten times what it represents in the place to its right.	2. These standard calls for students to extend their understanding of place value related to multiplying and dividing by multiples of 10. For example, recognize that $700 \div 70 = 10$ by applying concepts of place value and division.

<table>
<tr><td>3. Read and write multi-digit whole numbers represented with base-ten numerals, number names, and expanded form; compare pairs of multi-digit numbers; use >, =, and < symbols to record comparisons.</td><td>3. This standard refers to various ways to write numbers. Traditional expanded form is 285 = 200 + 80 + 5. Written form or number name is two hundred eighty-five. 285 could also be 28 tens plus 5 ones or 1 hundred, 18 tens, and 5 ones.</td></tr>
<tr><td>4. Round multi-digit whole numbers to the nearest hundred, thousand, and ten thousand.</td><td>4. This standard refers to place value understanding, which extends beyond an algorithm or procedure for rounding.
Example:
Round 368 to the nearest hundred.

</td></tr>
<tr><td>5. Use the standard algorithm with fluency to add and subtract multi-digit whole numbers.</td><td>5. Students build on their understanding of addition and subtraction.</td></tr>
<tr><td>6. Identify the relative sizes of centimeters, meters, and kilometers; grams and kilograms; ounces and pounds; milliliters and liters; seconds, minutes, and hours.

Express a measurement in a larger unit in terms of a smaller unit within the same system of measurement.

Record equivalent measurements in different units from the same system of measurement using a 2-column table.</td><td>Example: For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...
6.
<table><tr><th>kg</th><th>g</th></tr><tr><td>1</td><td>1000</td></tr><tr><td>2</td><td>2000</td></tr><tr><td>3</td><td>3000</td></tr></table>
<table><tr><th>ft</th><th>in</th></tr><tr><td>1</td><td>12</td></tr><tr><td>2</td><td>24</td></tr><tr><td>3</td><td>36</td></tr></table>
<table><tr><th>lb</th><th>oz</th></tr><tr><td>1</td><td>16</td></tr><tr><td>2</td><td>32</td></tr><tr><td>3</td><td>48</td></tr></table></td></tr>
<tr><td>7. Solve story problems involving distance, time, liquid volume, and mass using addition, subtraction, multiplication, and division of whole numbers.
Solve story problems that involve expressing measurements given in a larger unit in terms of a smaller unit within the same system of measurement; use diagrams to represent measurement quantities.</td><td>7. This standard includes multi-step word problems (measurements) (e.g., feet to inches, meters to centimeter, and dollars to cents).</td></tr>
</table>

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Can you use base ten numerals, number names, and expanded form to read and write multi-digit numbers and compare multi-digit numbers correctly?	1. Numbers can be written in a variety of ways, including base ten numerals, number names, and in expanded form. For example, 15,675 can also be written as fifteen thousand, six hundred seventy-five or 10,000 + 5,000 + 600 + 70 + 5.
2. Can you choose an efficient and effective strategy for adding and subtracting multi-digit numbers, and then use it to get the correct answer?	2. There are standard algorithms for multi-digit addition and subtraction that work in a consistent and reliable manner for all combinations. There are also other strategies that may prove more efficient depending upon the numbers being added and subtracted.
3. Can you round numbers to the nearest hundred, thousand, and ten thousand?	3. Multi-digit numbers can be rounded finely or more broadly, depending on the degree of accuracy required.
4. Can you convert larger units to smaller units within the same measurement system? For example, do you know how many ounces there are in a pound, how many meters in a kilometer, and how many milliliters in a liter?	4. Within one system of measurement, larger units can be converted to smaller units and vice versa, and these conversions can be displayed in two-column tables, enabling students to solve problems and generalize.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Books / Media:

- A Hundred Billion Trillion Stars
- Can You Count to a Googol?
- Let's Estimate
- Number and Operations Books
- On Beyond a Million
- Sir Cumference and All the King's Tens
- For Good Measure
- How Long or How Wide?
- Measurement Books
- Millions to Measure
- Tiger Math

Online Resources / Websites:

- Math Learning Center: Number Line App
- Math Learning Center: Number Pieces App
- Activity: Mostly Postie
- Game: The Ruler Game

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

Algorithm: A process or set of rules to be followed in calculations or other problem-solving operations.
Bar graph: A diagram in which the numerical values of variables are represented by the height or length of lines or rectangles of equal width.
Centimeter (cm): A metric unit of length equal to 1⁄1 of a meter or about 2⁄5 of an inch.
Cup: A customary unit of capacity equal to 8 fluid ounces.
Customary system: The system of measurement used in the United States; includes units for measuring length, capacity, weight, and temperature.
Difference: The result of subtracting one number from another.
Elapsed time: The amount of time that passes from the start of an event to its finish.

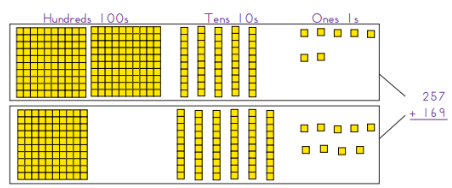
Expanded form: To break up a number according to its place value and expand it to show the value of each digit.
Foot (ft.): A unit of length (or distance) in US units equal to 12 inches.
Gallon (gal.): A customary unit of capacity equal to 4 quarts or 16 cups or 128 fluid ounces.
Gram (g): A metric unit of mass equal to one-thousandth of a kilogram or about the weight of a standard paperclip.
Inch (in.): A customary unit of length equal to 1⁄12 of a foot.
Kilogram (kg): A metric unit of mass equal to 1,000 grams or about 2.2 pounds.
Kilometer (km): A metric unit of length equal to 1,000 meters (approximately 0.62 miles).
Line plot: A Line plot can be defined as a graph that displays data as points or check marks above a number line, showing the frequency of each value.
Liter (l): A metric unit of capacity equal to 1,000 milliliters or about a quart.
Mass: A measure of the amount of matter in an object measured in grams, kilograms, etc.
Maximum: The largest value.
Median: The middle of a sorted list of numbers.
Meter (m): A metric unit of length equal to 100 centimeters or about 39 inches.
Metric system: A system of measurement based on tens.
Mile (mi.): A customary unit of distance. It is generally used to express the distance between cities, roads, and the length of rivers.
Milliliter (ml): A metric unit of capacity equal to one-thousandth of a liter.
Millimeter (mm): A millimeter is a unit measuring length in the metric system. A millimeter is one-thousandth of a meter.
Minimum: The smallest value.
Mode: The most frequent number—that is, the number that occurs the highest number of times. Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)
Ounce (oz.): A customary unit of weight equal to one-sixteenth of a pound.
Pint (pt.): A customary unit of capacity equal to one-eighth of a gallon or 2 cups or 16 fluid ounces.
Pound (lb.): A customary unit of weight equal to 16 ounces.
Quart (qt.): A customary unit of capacity equal to one-fourth of a gallon or 4 cups or 32 fluid ounces.
Range: The difference between the lowest and highest values.
Rounding: Making a number simpler but keeping its value close to what it was. The result is less accurate, but easier to use.
Scale: The ratio that defines the relation between the actual figure and its model.
Sum or total: The result of adding two or more numbers.
Table: Information (such as numbers and descriptions) arranged in rows and columns.
Volume: The space occupied within the boundaries of any three-dimensional solid.

Learning Plan

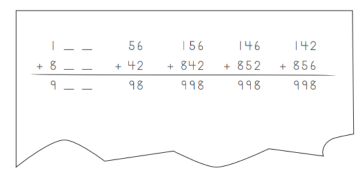
Overview and Key Learning Events and Instruction Per Week

In this unit, students study addition, subtraction, and measurement concepts. As part of their work, students investigate and use the standard addition and subtraction algorithms. They compare the use of algorithms to other methods and generalize about which work best for certain problems. In Module 3, students explore length and distance, liquid volume, time, mass, and weight. They investigate the relationships between common measures, and they solve problems that require them to convert measurements to smaller units within the same system of measure.

Week 1, Place Value & the Standard Addition Algorithm: This module focuses on place value to 1,000,000 and multi-digit addition strategies. Students use the Great Wall of Base Ten to develop an understanding of place value to 10,000 and then build a model showing 1,000,000 units (a mat-mat-mat). These activities help students see patterns and relationships in the base ten counting system. They use what they learn about place value to investigate and review addition strategies for larger numbers. They learn the standard algorithm for addition and compare it to other strategies they have learned. Students also learn two new Work Places during the module: Target One Thousand and Add, Round & Compare. The teacher collects a Work Sample in Session 6, and the module ends with a checkpoint that addresses place value and addition.

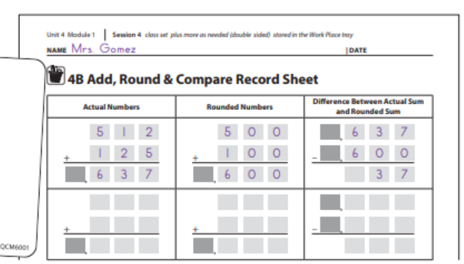


Step 1: Set up the combination (257 + 169) with base ten pieces.



Problem String Give & Take, Part 1

Problems	Sample Strategies & Recording	Connections
36 + 99	Start with the 99 because it's so close to 100. Add 1 to get 100. Then add what's left, 35, so it's 135. 1 35 99 100 135 99 + 36 = 99 + (1 + 35) = (99 + 1) + 35 = 100 + 35	Posing combinations in which one of the addends is within just a few, or even 1, of a multiple of 100, facilitates the idea of taking that amount from the other addend to make an easier combination. This is all the more the case if it is easy to remove the needed amount from the other addend.
697 + 178	Give 3 to 697 to get 700. Then 700 and 175 is 875. 3 175 697 700 875 697 + 178 +3 −3 = 700 + 175 = 875	**Big Idea** Combinations in which one of the addends is close to a multiple of 100 lend themselves to a give and take strategy.



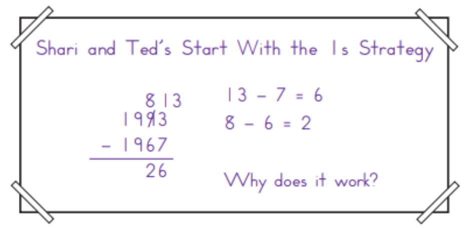
Week Two: The Standard Subtraction Algorithm: The focus shifts to subtraction in Module 2. Problem strings and story problems help students deepen their understanding of and flexibility with subtraction strategies, including difference versus removal and constant difference. Students learn the standard algorithm for subtraction and compare it to other strategies they have explored. They also learn one new Work Place: Roll & Subtract One Thousand. The teacher collects a Work Sample in Session 4 that provides information about students' proficiency with methods for solving multi-digit subtraction combinations. Students will also show what they have learned on a brief checkpoint at the beginning of Module 3.

Problem String How Old?, Part 2

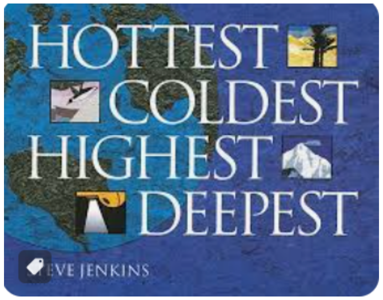
Problems	Sample Strategies & Recording	Comments
If Uncle Terry was born in 1947, how old was he in 1992? 1992 – 1947	3 + 42 = 45 1947 1950 1992 Finding the Difference	Once you've solicited answers, invite students who have used differencing to share their strategies. Record their thinking on open number lines.
If Cousin George was born in 1999, how old was he in 2005? 2005 – 1999	1 + 5 = 6 1999 2000 2005 Finding the Difference	
If Timmy was 15 in 1996, when was he born? 1996 – 15	–9 –6 1981 1990 1996 Removing (Taking Away)	Again, once you've solicited answers, invite students who have used removal/take away to share their strategies. Record their thinking on open number lines.
If Kim was 8 in 2003, when was she born? 2003 – 8	–5 –3 1995 2000 2003 Removing (Taking Away)	

Problem String Constant Difference, Part 2

Problems	Sample Strategies & Recording	Connections
262 – 235	5 + 22 = 27 235 240 262	**Big Idea** The answer is the same from one problem to the next in this string because the difference has been held constant from one to the next. Notice that in the second problem, both the minuend and the subtrahend have been decreased by 2. In the third, both numbers have been decreased by 6. In the last problem, both numbers have been increased by 3, and students might well identify this as the easiest in the string, due to the fact that the subtrahend is a multiple of 10.
260 – 233	27 233 260	
254 – 227	27 227 254	
257 – 230	27 230 257	



Week Three: Measurement: This module gives students an opportunity to explore benchmarks and relative sizes for length, time, liquid volume, mass, and weight. Students use ratio tables to convert units within the same measuring system and apply some of the place value and multi-digit computation skills they've been practicing solving story problems related to measurement.



Measurement Words

Length	Time	Mass/Weight	Volume/Capacity
inch	second	ounce	ounce
foot	minute	pound	cup
yard	hour	gram	pint
mile	day	kilogram	quart
centimeter	week		gallon
meter	month		milliliter
kilometer	year		liter
	decade		

	ounces	pounds	
× 10	16	1	× 10
× 5	160	10	× 5
	80	5	
	240	15	

Write 1,000 g = 1 kg on the board. Ask students to use this relationship to determine how many kilograms are equivalent to 4,000 grams.

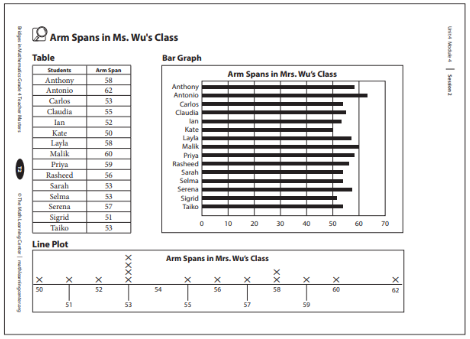
Give students time to solve the problem in their journals. Then model a volunteer's thinking on a ratio table.

> ***Student*** *I was going to go in order, like 1 kg, 2 kg, 3 kg, and then 4 kg, but then I realized I could just multiply both sides by 4 and see that 4,000 grams is 4 kilograms.*

kilograms	grams
1	1,000
?	4,000

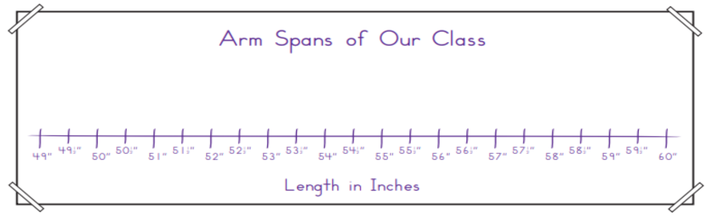
	kilograms	grams	
× 4	1	1,000	× 4
	4	4,000	

Week Four: 4 Measurement & Data Displays: Unit 4 concludes with a two-session project that gives students an opportunity to apply some of their measuring skills in a new context—data analysis. During the last session of this module students take the Unit 4 Post-Assessment.


Arm Spans in Ms. Wu's Class

Table

Students	Arm Span
Anthony	58
Antonio	62
Carlos	53
Claudia	55
Ian	52
Kate	50
Layla	58
Malik	60
Priya	59
Rasheed	56
Sarah	53
Selma	53
Serena	57
Sigrid	51
Taiko	53



11 Invite a few students at a time to come up and post their sticky notes on the line.

12 Ask students to share observations about the line plot, first in pairs, and then as a whole group.

- Look for opportunities to review or introduce the following words: *minimum, maximum, range, mode,* and *median.*

Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)

Unit 4

Big Numbers by Edward Packard

Can You Count to a Googol? (Wells of Knowledge Science) by Robert E. Wells

On Beyond a Million: An Amazing Math Journey by David M. Schwartz

Is a Blue Whale the Biggest Thing There Is? (Wells of Knowledge Science) by Robert E. Wells

For Good Measure: The Ways We Say How Much, How Far, How Heavy, How Big, How Old by Ken Robbins

How Long or How Wide?: A Measuring Guide (Math Is Categorical) by Brian P. Cleary

Millions to Measure by David M. Schwartz, Steven Kellogg

Tiger Math: Learning to Graph from a Baby Tiger by Ann Whitehead Nagda, Cindy Bickel

- Students reason abstractly and quantitatively when they connect the base ten pieces to written numerals that represent quantities. Doing so helps them build a sense of numbers of this magnitude so that they can estimate and compute with understanding.
- Combinations in which one of the addends is close to a multiple of 100 lend themselves to a give and take strategy.
- Throughout your work with addition, encourage students to think in terms of the values involved when they consider whether an answer is reasonable. This means the numbers with the largest place values receive the most weight. For example, to add 158 + 275, encourage students to think about 100 + 200 = 300 rather than 8 + 5 = 13. Even without rounding, this helps students develop a habit of thinking about whether an answer is reasonable.
- We often think of tools in terms of manipulatives, models, or technological aids, but different methods for solving multi-digit addition combinations are also tools to be chosen carefully and deployed strategically. Ideally, students will choose methods based on the numbers themselves, selecting the standard algorithm for a combination such as 5,867 + 3,547 but opting for a method such as compensation instead to solve a combination in which one of the addends is very close to a multiple of 100 or 1,000.
- Students think carefully about the strategies and about number relation- ships when justifying their selection of strategy for a particular kind of problem. When they construct viable arguments and critique the reasoning of others in this way, they gain clarity about when it makes the best sense to use a particular strategy.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

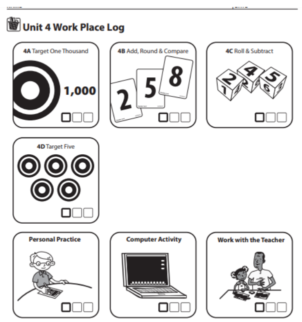
The Westbrook Student will meet expectations by…

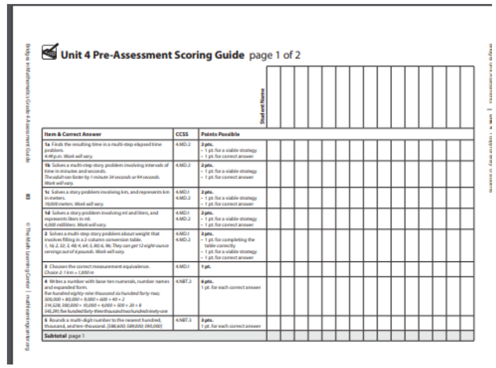
☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

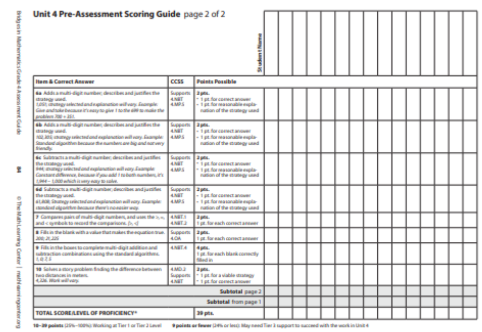
Differentiation
Challenge: ● Ask students to create their own version of a work place and teach another pair of students how to play ● See “Game Variations” in work place guides ● See “Assessment and Differentiation” in work place teacher masters
Support: ● When applicable give students smaller numbers to practice the strategies ● When working with larger numbers, give students the addition/subtraction charts to support basic fact recall ● See “Game Variations” in work place guides ● See “Assessment and Differentiation” in work place teacher masters
ELL: ● Have pairs of ELL students observe another pair of students playing work places before playing it themselves. ● Have pairs of ELL students sit with another pair of students as they play a work place. ● Other students can offer step-by-step instructions while they play. ● Make visual word resource cards available to students who need extra language support. ● Give students visual word cards. ○ This will support non-academic vocabulary as necessary.

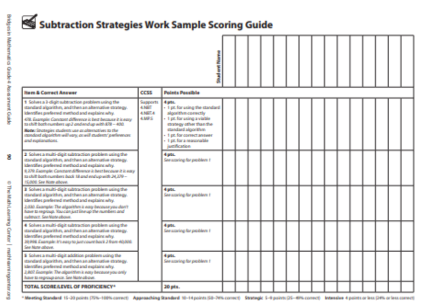
Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: ● Unit 4 Pre-Assessment ● Addition Strategies Work Sample ● Place Value and Addition Checkpoint ● Subtraction Strategies Work Sample ● Subtraction Checkpoint ● Work Places ● Home Connections

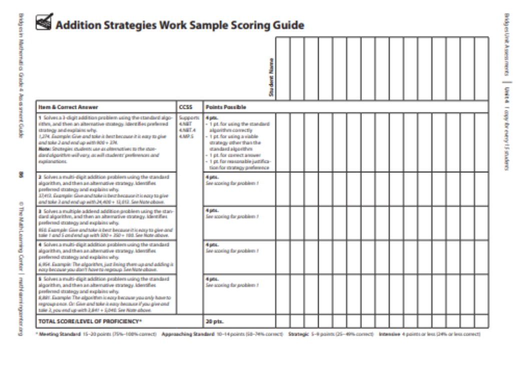
- Student Book Class Work

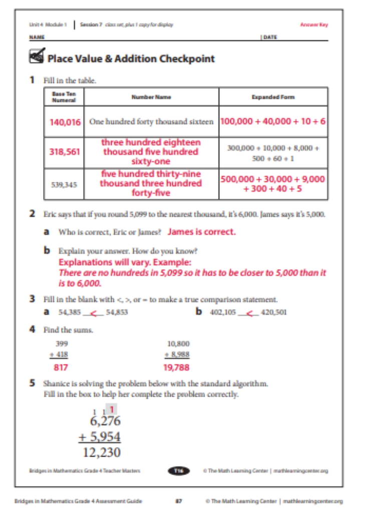

Unit 4 Work Place Log

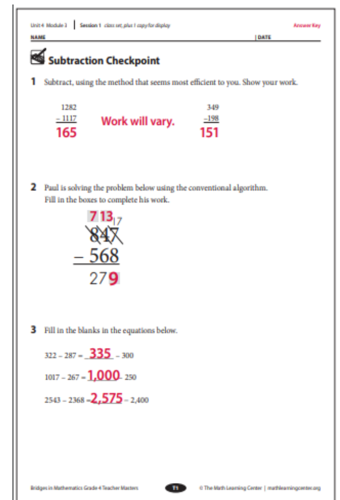

Unit 4 Pre-Assessment Scoring Guide page 1 of 2


Unit 4 Pre-Assessment Scoring Guide page 2 of 2


Subtraction Strategies Work Sample Scoring Guide


Addition Strategies Work Sample Scoring Guide


Place Value & Addition Checkpoint


Subtraction Checkpoint

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 4 Post Assessment

Unit 4 Post-Assessment Scoring Guide page 2 of 2

Student Name

Item & Correct Answer	CCSS	Points Possible															
6a Adds a multi-digit number; describes and justifies the strategy used. *1,231; strategy selected and explanation will vary. Example: Give and take because it's easy to give 1 to the 799 to make the problem 800 + 431.*	Supports 4.NBT 4.MP.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for reasonable explanation of the strategy used															
6b Adds a multi-digit number; describes and justifies the strategy used. *83,204; strategy selected and explanation will vary. Example: Standard algorithm because the numbers are big and not very friendly.*	Supports 4.NBT 4.MP.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for reasonable explanation of the strategy used															
6c Subtracts a multi-digit number; describes and justifies the strategy used. *3,512; strategy selected and explanation will vary. Example: Constant difference, because if you add 12 to both numbers, it's 10,512 – 7,000 which is very easy to solve.*	Supports 4.NBT 4.MP.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for reasonable explanation of the strategy used															
6d Subtracts a multi-digit number; describes and justifies the strategy used. *9,089; strategy selected and explanation will vary. Example: Standard algorithm because there's no easier way.*	Supports 4.NBT 4.MP.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for reasonable explanation of the strategy used															
7 Compares pairs of multi-digit numbers, and uses the >, =, and < symbols to record the comparisons. *[<, <]*	4.NBT.1 4.NBT.2	**2 pts.** • 1 pt. for each correct answer															
8 Fills in the blank with a value that makes the equation true. *[300; 31,764]*	Supports 4.OA	**2 pts.**															
9 Fills in the boxes to complete multi-digit addition and subtraction combinations using the standard algorithms. *1, 0; 6, 9*	4.NBT.4	**4 pts.**															
10 Solves a story problem finding the difference between two distances in meters. *1,348 meters. Work will vary.*	4.MD.2 Supports 4.NBT	**2 pts.** • 1 pt. for a viable strategy • 1 pt. for correct answer															
		Subtotal page 2															
		Subtotal from page 1															
TOTAL SCORE/LEVEL OF PROFICIENCY*		**39 pts.**															

* **Meeting Standard** 30–39 points (75%–100% correct) **Approaching Standard** 20–29 points (50–74% correct) **Strategic** 10–19 points (25–49% correct) **Intensive** 9 points or less (24% or less correct)

Unit 4 Post-Assessment Scoring Guide page 1 of 2

Student Name

Item & Correct Answer	CCSS	Points Possible															
1a Finds the resulting time in a multi-step elapsed time problem. *5:35 a.m. Work will vary.*	4.MD.2	**2 pts.** • 1 pt. for a viable strategy • 1 pt. for correct answer															
1b Solves a story problem involving intervals of time in minutes and seconds. *Pete; 37 seconds. Work will vary.*	4.MD.2	**2 pts.** • 1 pt. for a viable strategy • 1 pt. for correct answer															
1c Solves a story problem involving km, and represents km in meters. *33,000 meters. Work will vary.*	4.MD.1 4.MD.2	**2 pts.** • 1 pt. for a viable strategy • 1 pt. for correct answer															
1d Solves a story problem involving ml and liters, and represents liters in ml. *4,200 milliliters. Work will vary.*	4.MD.1 4.MD.2	**2 pts.** • 1 pt. for a viable strategy • 1 pt. for correct answer															
2 Solves a multi-step story problem about mass that involves filling in a 2-column conversion table. *1, 1,000; 2, 2000; 3, 3000; 4, 4000; 5, 5000; 6, 6000. They can get twenty 250-gram servings out of a 5-kilogram watermelon. Work will vary.*	4.MD.1 4.MD.2	**3 pts.** • 1 pt. for completing the table correctly • 1 pt. for a viable strategy • 1 pt. for correct answer															
3 Chooses the correct measurement equivalence. *100 cm = 1 m*	4.MD.1	**1 pt.**															
4 Writes a number with numerals, words & expanded form. *six hundred seventy nine thousand, five hundred twenty-seven; 600,000+70,000+9,000+500+20+7; 417,235; 400,000+10,000+7,000+200+30+5; 869,478; eight hundred sixty-nine thousand, four hundred seventy-eight*	4.NBT.2	**6 pts.** • 1 pt. for each correct answer															
5 Rounds a multi-digit number to the nearest hundred, thousand, and ten thousand. *[676,500; 677,000; 680,000]*	4.NBT.3	**3 pts.** • 1 pt. for each correct answer															
		Subtotal page 1															

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 5: Geometry and Measurement
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
4.MD.3 Apply the area formula for a rectangle to solve a problem.
4.MD.5 Identify an angle as a geometric figure formed where two rays share a common endpoint.
4.MD.5a Measure angles by identifying the fraction of the circular arc between the points where the two rays forming the angle

intersect the circle whose center is at the endpoints of those rays.
4.MD.5b Identify the measure of an angle by identifying the total number of one-degree angles through which it turns.
4.MD.6 Use a protractor to measure angles in whole degrees; sketch an angle of a specified measure.
4.MD.7 Decompose an angle into non-overlapping parts
4.MD.7 Express the measure of an angle as the sum of the angle measures of the non-overlapping parts into which it has been decomposed.
4.MD.7 Solve problems involving finding the unknown angle in a diagram, using addition and subtraction.
4.MD.7 Demonstrate an understanding that angle measure is additive.
4.G.1 Identify points, lines, line segments, rays, and angles (right, acute, obtuse), parallel lines, and perpendicular lines in 2-D figures.
4.G.1 Draw angles (right, acute, and obtuse), parallel lines, and perpendicular lines.
4.G.2 Classify 2-D figures based on the presence or absence of parallel lines, perpendicular lines, and angles of a specified size; identify right triangles.
4.G.3 Identify and draw lines of symmetry; identify figures with line symmetry.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Describe, classify, and analyze shapes and angles. 2. Measure, add, and subtract angles.	1. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint and understand concepts of angle measurement. 2. Know that an angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is

3. Recognize and draw lines of symmetry in 2-dimensional figures.	called a "one-degree angle" and can be used to measure angles. 3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Can you draw figures with line symmetry, and draw in the lines of symmetry accurately?	1. Shapes are symmetrical if they can be split in half and both sides are mirror images of each other. Some shapes have symmetry, and some do not.
2. Can you draw, measure and sketch angles?	2. Equipped with the ability to measure, sketch, and think about angles, students can start considering whether it would be possible for a triangle to have more than one obtuse angle, or for a trapezoid to have more than two right angles, or for a parallelogram to have both acute and obtuse angles.
3. Can you draw parallel lines and perpendicular lines and find them in 2-D figures?	3. Identify shapes and angles based on the knowledge of different line types.
4. Can you identify shapes that are triangles and quadrilaterals that are not and are not parallelograms?	4. Classify quadrilaterals based on parallel and perpendicular sides, distinguishing between two entire classes—trapezoids and parallelograms—based on the fact that trapezoids have exactly one pair of parallel sides while parallelograms have two pairs of parallel sides.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Informational Texts:
• **Informational Books:**
    ○ Hamster Champs
    ○ Sir Cumference and the Isle of Immeter
    ○ Amazon Booklist: Measurement
• **Media:**
    ○ Clock Angles
    ○ Line Symmetry Video
    ○ Activity: Shape Explorer
 	
Online Resources / Websites:
• MLC App: Pattern Shapes
• MLC App: Geoboard
• Game: Alien Angles
• Game: Angle Shoot
• Game: Fractris
• Game: Symmetry Artist
• MLC: Workplace Sentence Frames

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Acute Angle:** an angle with a measure greater than 0° and less than 90°. **Angle:** the figure formed by 2 rays or line segments that share an endpoint; often measured in terms of the amount of rotation

(expressed as some number of degrees) needed to superimpose one of those rays or line segments onto the other.
Area: the total number of square units needed to cover a two-dimensional surface.
Centimeter (cm): a metric unit of length equal to 1⁄1 of a meter or about 2⁄5 of an inch.
Circle: a two-dimensional (flat) shape made by drawing a curve that is always the same distance from a point called the center.
Circumference: the distance around a circle, cylinder, or widest part of a sphere.
Congruent: of the same shape and size; two shapes are congruent if one can be exactly superimposed onto the other using a sequence of rotations, reflections, and/or translations.
Degree: a unit used to measure the size of angles; 1 degree is equal to 1⁄36 of a full rotation.
Diameter: a line segment between two points on a circle that passes through the center of the circle.
Dimension: the length, width, or height of a figure.
Equilateral Triangle: a triangle with all sides the same length.
Fraction: a number expressed as some number of equal parts of a whole.
Hexagon: a two-dimensional (flat) shape with 6 sides.
Interior Angle: an angle inside of a shape.
Isosceles Triangle: a triangle with exactly 2 congruent sides.
Line: a set of connected points that continues in both directions without end (if it has two endpoints it is a line segment, and if it has one endpoint and continues in one direction without end, it is a ray).
Line of Symmetry: a real or imaginary line that divides a shape into two mirror images.
Line Segment: the set of all points between two endpoints.
Metric System: a system of measurement based on tens.
Obtuse Angle: an angle with a measure greater than 90° and less than 180°.
Parallel: always the same distance apart.
Parallelogram: a two-dimensional (flat) shape with 4 sides, with both pairs of opposite sides parallel.
Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference.
Perpendicular: intersecting at right angles.
Polygon: a closed two-dimensional (flat) shape with 3 or more sides.
Protractor: a tool used to measure angles (including angles you want to draw).
Quadrilateral: a two-dimensional (flat) shape with 4 sides.
Radius: any line segment that extends from the center of a circle to a point on the circumference of the circle.
Ray: a set of connected points that continues in one direction without end.
Rectangle: a two-dimensional (flat) shape with two pairs of parallel sides (4 sides total) and 4 right angles.
Rhombus: a two-dimensional (flat) shape with 4 congruent sides.
Right Angle: an angle with a measure of exactly 90°.

Right Triangle: a triangle with 1 right angle (1 angle that measures exactly 90°).
Rotation: a turn of a geometric figure.
Scalene Triangle: a triangle whose sides are all different lengths.
Square Centimeter (cm):
Square Unit: a square with sides that measure 1 unit, used to measure area.
Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles.
Straight Angle: an angle with a measure of exactly 180°.
Symmetry: the property of a shape that can be folded so that the two halves match exactly.
Trapezoid: a two-dimensional (flat) shape with 4 sides, exactly 1 pair of which are parallel.
Vertex or Corner: the point at which the sides of a two-dimensional (flat) shape or the edges of a three-dimensional shape (solid) intersect.
Yard (yd.): a customary unit of length equal to 3 feet or 36 inches.
Zero Angle: an angle whose measure is zero degrees.

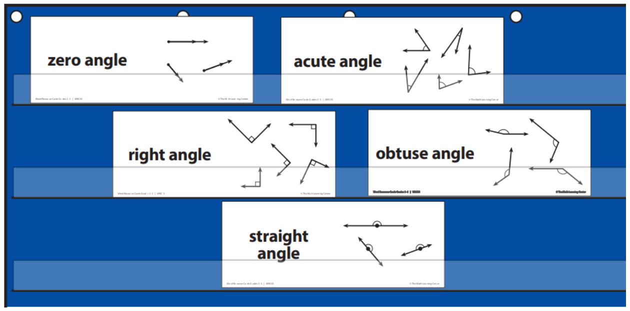
Learning Plan

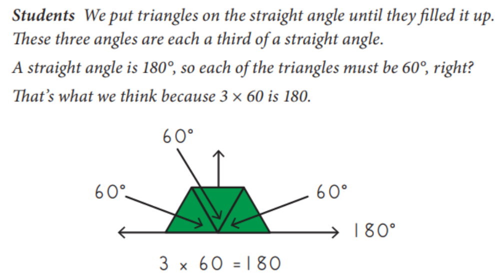
Overview and Key Learning Events and Instruction Per Week

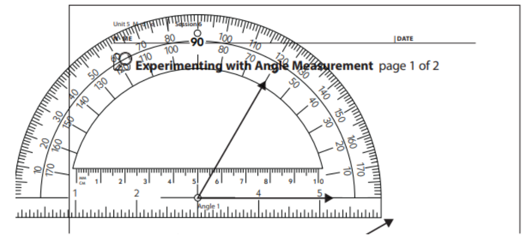
In this unit, students are formally introduced to a host of new geometric concepts, including angles and angle measure, parallel and perpendicular lines, and reflective symmetry. In Module 1, students focus on comparing, analyzing, classifying, and measuring angles. In Module 2, students investigate parallel and perpendicular lines as well as line symmetry and use these terms and concepts to sort and classify a wide variety of polygons. During Module 3, students measure the area and perimeter of rectangles, generalizing that support the introduction of the formulas for both. Module 4 features a return to angle measure, with an emphasis on the fact that angles involve turns or rotations around a fixed point and are additive in nature.

Learning Tasks Per Week (Including Instructional Strategies)

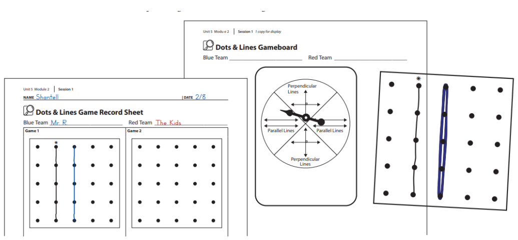
Week One: Measuring Angles: In this module students identify, draw, compare, analyze, and classify angles. Students study angles in isolation as well as those in two-dimensional figures. They use two very basic benchmarks—the 90° right angle and the 180° straight angle—to determine the measure of the interior angles in each of the pattern blocks. The pattern blocks then serve as a tool for checking their work as they move into measuring and sketching angles with a 180° protractor. The module ends with an examination of circles in which students identify parts of a circle, learn that there are 360° in a full turn, and discover that angles, rather than being static, are measures of rotation.

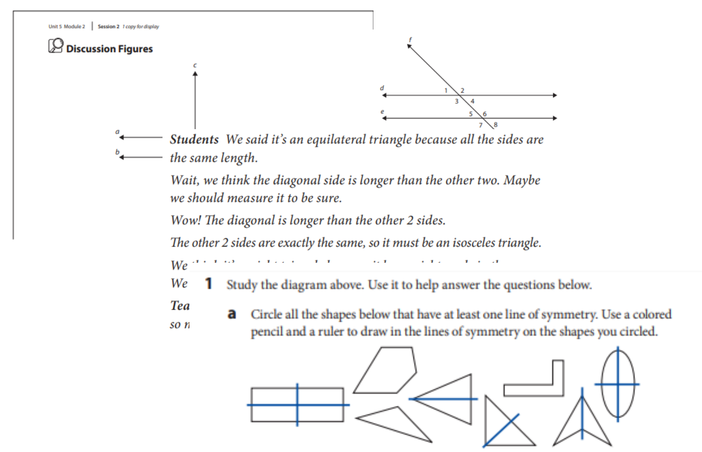




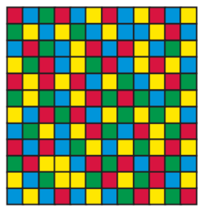


Week Two: Polygons & Symmetry: In Module 2, students extend their work with angles and explore attributes of polygons. In Sessions 1 and 2, students identify and draw parallel and perpendicular lines. They also practice drawing a variety of angles and lines and complete a work sample drawing lines and measuring angles. Session 3 introduces students to lines of symmetry, and they work to define and create examples of polygons with one or more lines of symmetry. In Session 4, students review different types of triangles, quadrilaterals, and other polygons as they create a set of polygon cards for use in Sessions 5 and 6. In Session 5, they use their polygon cards to help solve a collection of riddles posed by the teacher.





Week Three: Area & Perimeter: In the first three sessions of this module, students review concepts related to measuring area and perimeter. They make observations concerning both types of measure, which leads to generalized formulas. In Session 4, students have opportunities to apply these formulas as they solve problems involving areas and perimeters of complex figures.

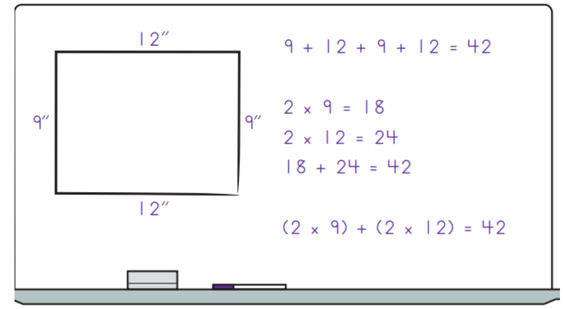

Distribute sets of tiles to groups of four students. Ask them to work together in their groups to build a square with an area of exactly 144 square inches.

After they've had a few minutes to work, have them share and compare their results.

Students *We thought it was going to be really big, but it's not so big after all.*

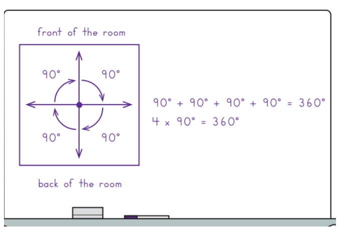
We knew it was going to be a 12″ × 12″ square because 12 × 12 is 144.

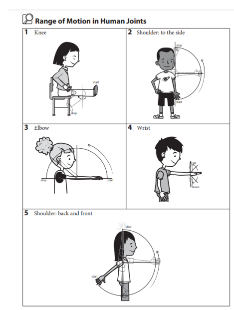
We each made 3 rows of 12 and put them together. It went pretty fast for us.

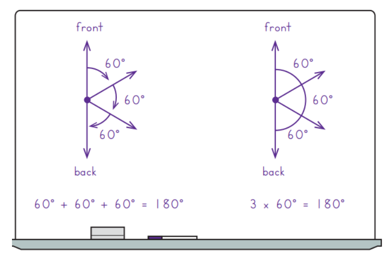

11 Then ask students to share any generalizations they can make about how to

and share their thinking.

Week Four: Angles in Motion: Module 4 features a return to angles, with an emphasis on the fact that angles are dynamic in that they involve a turn or rotation around a fixed point. Students approximate the angles of rotation for various joints in their own bodies, including their knees, wrists, shoulders, and elbows. Then the students stand in place and make turns of specified sizes as they solve problems that involve adding angles. In Session 3, they share and compare strategies and solutions to these problems during a math forum. Finally, they take the Unit 5 Post-Assessment.







Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)

Unit 5

Hamster Champs (MathStart 3) by Stuart J. Murphy

Sir Cumference and the Isle of Immeter (Math Adventures) by Cindy Neuschwander

Spaghetti and Meatballs for All by Marilyn Burns

- Using the pattern blocks to draw angles in constructing viable arguments and critiquing the reasoning of others, students must draw upon their knowledge and understanding of symmetry and of the attributes of the featured shapes. Engaging in respectful discussion and debate presses students to clarify their thinking and deepen their understandings. Helps students reason quantitatively about angle measurement. Each block gives students a concrete sense of what a particular angle measurement looks like, as well as how it relates to other benchmark angles like 90° and 180°. After using the pattern blocks in this way, students are better prepared to reason more abstractly about angle measurement.
- Using precise language helps clarify and deepen their understanding of circles, and attending to precision when using the protractor helps them develop a better sense of angles and their measurement.
- In constructing viable arguments and critiquing the reasoning of others, students must draw upon their knowledge and understanding of symmetry and of the attributes of the featured shapes. Engaging in respectful discussion and debate presses students to clarify their thinking and deepen their understanding.
- Solving riddles provides a structured way to help students get into the habit of making sense of problems and persevere in solving them. As students puzzle through each clue, they get closer to arriving at the final solution: the polygon that meets all the criteria.
- Students model with mathematics when they measure and calculate the area of a rectangle using the square tiles. By handling and using a model of a square inch and a square foot, students develop a deeper understanding of what area is, as well as a better intuitive sense of the size of each unit of area measure.
- When developing an understanding of formulas and algorithms, students look for and make use of regularity in repeated reasoning. The process of repeatedly solving similar problems and looking for regularity in that repetition helps students develop an understanding of the formulas before using them widely.
- Students use the known angles of the pattern blocks, along with benchmark angles like 90 and 180 degrees, to estimate the angle formed by the complete rotation of each joint. This is an example of using appropriate tools strategically, which, in this case, enhances students' understanding of angle measurement.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

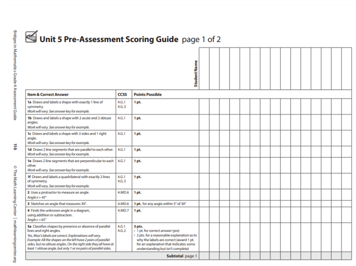
Differentiation
Challenge: ● Ask students to create their own version of a work place and teach another pair of students how to play ● See "Game Variations" in work place guides ● See "Assessment and Differentiation" in work place teacher masters
Support: ● When applicable give students smaller numbers to practice the strategies ● When working with larger numbers, give students the addition/subtraction charts to support basic fact recall. ● See "Game Variations" in work place guides ● See "Assessment and Differentiation" in work place teacher masters
ELL: ● Have pairs of ELL students observe another pair of students playing work places before playing it themselves. ● Have pairs of ELL students sit with another pair of students as they play a work place so that other students can offer step-by-step instructions while they play. ● Make visual word resource cards available to students who need extra language support. ● Give students visual word cards for non-academic vocabulary as necessary.

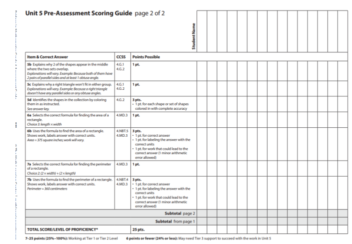
Assessments

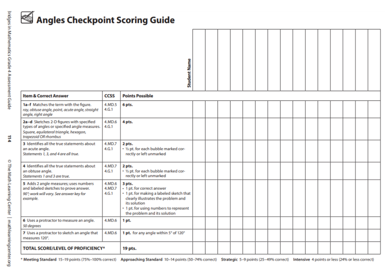
Include an overview of authentic assessments

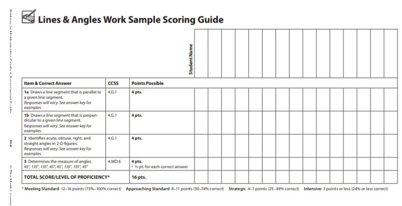
Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

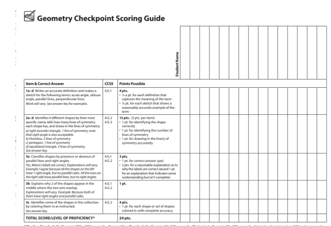
- Unit 5 Pre-Assessment
- Angles Checkpoint
- Lines and Angles Work Sample
- Geometry Checkpoint
- Work Places
- Home Connections
- Student Book Class Work

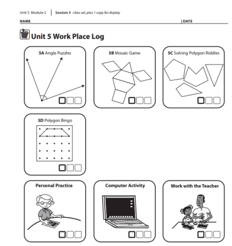

Unit 5 Pre-Assessment Scoring Guide page 1 of 2


Unit 5 Pre-Assessment Scoring Guide page 2 of 2


Angles Checkpoint Scoring Guide


Lines & Angles Work Sample Scoring Guide


Geometry Checkpoint Scoring Guide


Unit 5 Work Place Log

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 5 Post Assessment

Unit 5 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1a Draws and labels a polygon with exactly 2 lines of symmetry. *Work will vary. See answer key for example.*	4.G.1 4.G.3	**1 pt.**	
1b Draws a triangle of any sort. Labels each of the angles as acute, obtuse, or right. *Work will vary. See answer key for example.*	4.G.1	**1 pt.**	
1c Draws and labels a polygon with 4 sides and 1 obtuse angle. *Work will vary. See answer key for example.*	4.G.1	**1 pt.**	
1d Draws 3 line segments of different lengths that are all 3 parallel to one another. *Work will vary. See answer key for example.*	4.G.1	**1 pt.**	
1e Draws a polygon with at least 2 sides perpendicular to each other. Labels one pair of sides that are perpendicular to each other. *Work will vary. See answer key for example.*	4.G.1	**1 pt.**	
1f Draws and labels a pentagon with exactly 1 line of symmetry. *Work will vary. See answer key for example.*	4.G.3	**1 pt.**	
2 Uses a protractor to measure an angle. *Angle x = 30°*	4.MD.6	**1 pt.**	
3 Sketches an angle that measures 50°.	4.MD.6	**1 pt.** for any angle within 5° of 50°	
4 Finds the unknown angle in a diagram, using addition or subtraction. *Angle c = 135°*	4.MD.7	**1 pt.**	
5a Classifies shapes by presence or absence of parallel lines and right angles. *Yes, Kelly's labels are correct. Explanations will vary. Example: All the shapes on the left have 2 pairs of parallel lines, but no right angles. The shapes on the right all have at least one right angle, but none of them have parallel sides. The ones in the middle have both.*	4.G.1 4.G.2	**3 pts.** • 1 pt. for correct answer (yes) • 2 pts. for a reasonable explanation as to why the labels are correct (award 1 pt. for an explanation that indicates some understanding but isn't complete)	
		Subtotal page 1	

Unit 5 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
5b Explains why 2 of the shapes appear in the middle where the two sets overlap. *Explanations will vary. See answer key.*	4.G.1 4.G.2	**1 pt.**	
5c Explains why it's not correct to say that a right triangle won't fit in either group. *No; explanations will vary. See answer key.*	4.G.1 4.G.2	**1 pt.**	
5d Identifies the shapes in the collection by coloring in and marking them as instructed. *See answer key.*	4.G.2	**3 pts.** • 1 pt. for each shape or set of shapes colored in or marked with complete accuracy	
6a Selects the correct formula for finding the area of a rectangle. *Choice 3: length × width*	4.MD.3	**1 pt.**	
6b Uses the formula to find the area of a rectangle. Shows work. Labels answer with correct units. *Area = 210 square inches; work will vary.*	4.NBT.5 4.MD.3	**3 pts.** • 1 pt. for correct answer • 1 pt. for labeling answer with correct units • 1 pt. for work that could lead to the correct answer (1 minor arithmetic error allowed)	
7a Selects the correct formula for finding the perimeter of a rectangle. *Choice 2: (2 × width) + (2 × length)*	4.MD.3	**1 pt.**	
7b Uses the formula to find the perimeter of a rectangle. Shows work. Labels answer with correct units. *Perimeter = 312 centimeters*	4.NBT.4 4.MD.3	**3 pts.** • 1 pt. for correct answer • 1 pt. for labeling answer with correct units • 1 pt. for work that could lead to the correct answer (1 minor arithmetic error allowed)	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**25 pts.**	

* **Meeting Standard** 19–25 points (75%–100% correct) **Approaching Standard** 13–18 points (50–74% correct) **Strategic** 7–12 points (25–49% correct) **Intensive** 6 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 6: Multiplication & Division, Data & Fractions
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** **1. Make sense of problems and persevere in solving them.** 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique reasoning of others. **4. Model with mathematics.** 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. **Priority/Focus Standards:** **4.OA.3** Solve multi-step story problems involving only whole numbers, using addition, multiplication and division. **4.NBT.5** Multiply a 2 or 3-digit whole number by a 1-digit whole number using strategies based on place value and the properties of operations.

4.NBT.5 Multiply two 2-digit numbers using strategies based on place value and the properties of operations. **4.NBT.5** Use equations or rectangular arrays to explain strategies for multiplying with multi-digit numbers. **4.NBT.6** Divide a 2- or 3-digit number by a 1-digit number, using strategies based on place value, the properties of operations, or the relationship between multiplication and division. **4.NBT.6** Use equations or rectangular arrays to explain strategies for dividing a multi-digit number by a 1-digit number. **4.NF.1** Use a visual model to explain why a fraction a/b is equivalent to a fraction (n × a)/(n × b). **4.NF.1** Use visual models to generate and recognize equivalent fractions. **4.NF.3c** Add and subtract fractions and mixed numbers with denominators. **4.NF.6** Write fractions with denominators 10 and 100 in decimal notation. **4.MD.3** Apply the area and perimeter formulas for a rectangle to solve a problem. **4.MD.4** Make a line plot to display a data set consisting of measurements taken in halves, fourths, and eighths of a unit. Supporting Standards: **4.OA** Solve single-step story problems involving division with remainders

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Select the best operation or group of operations to solve a multi-step problem. 2. Use estimation strategies to assess reasonableness of answers. 3. Use strategies to solve multi-digit multiplication problems.	1. Students use and discuss various strategies for solving word problems using all four operations. 2. Estimation strategies include identifying when estimation is appropriate, determining the level of accuracy needed, selecting the appropriate method of estimation, and verifying solutions or determining the reasonableness of situations using various estimation strategies. 3. Students should be able to apply their understanding of place value and various forms of a number to compute products. Students will also use area models, partial

	products and properties of operations to solve multiplication problems.
4. Use strategies to solve division problems with and without remainders.	4. Students should be able to apply their understanding of place value and various forms of a number to compute quotients. Students will also use arrays and area models, repeated subtraction, partial quotients and properties of operations to solve division problems.
5. Show and explain fraction equivalence.	5. Use area and length fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size.
6. Solve addition and subtraction problems with denominators.	6. Models should also be used to support students' work when they add and subtract fractions in the latter two bullets of this standard. When students are able to fluently decompose fractions, including mixed numbers, it supports their work when adding and subtracting fractions.
7. Use decimal notation to represent fractions.	7. Students should have ample opportunities to explore and reason about the idea that a number can be represented as both a fraction and a decimal. This standard establishes the connection that a fraction that has been equally partitioned into 10 or 100 equal parts (10th and 100ths) can also be written as a decimal. Students make connections between fractions with denominators of 10 and 100 and the place value chart.
8. Solve problems with area and perimeter.	8. Students learn to apply these understandings and formulas to the solution of real-world and mathematical problems. Note that "apply the formula" does not mean

	write down a memorized formula and put in known values. In fourth grade, working with perimeter and area of rectangles is still based on models and strategies.
9. Students will create frequency tables, scaled bar graphs or line plots based on the data collected.	9. Students will interact with data through data collection, creation of a scaled bar graph or a line plot, and interpretation of data. In third grade, students collected data by asking a question that yielded categorical data, which is data that can be grouped into categories. Students in fourth grade will build on that concept and begin to also ask questions that provide numerical data, which is data that is measurable such as time, height, weight, temperature, etc.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Can you use different strategies and properties to solve multiplication problems?	1. Students should be able to apply their understanding of place value and various forms of a number to compute products. Students will also use area models, partial products and properties of operations to solve multiplication problems.
2. Can you use different strategies and properties to solve division problems?	2. Students should be able to apply their understanding of place value and various forms of a number to compute quotients. Students will also use arrays and area models, repeated subtraction, partial quotients and properties of operations to solve division problems.
3. Can you determine the correct operation(s) needed to	3. Students need to be able to figure out and show the best

solve single and multi-step word problems? 4. Can you find the unknown dimension of a rectangle if you know the area or perimeter and one other dimension? 5. Can you complete a line plot to display data? 6. Can you add and subtract fractions and mixed numbers to solve problems about data on a line plot?	mathematical thinking for solving word problems. 4. Students will solve problems that involve exploration of the relationship between perimeter and area in a rectangle. When given a fixed area, students will be able to determine all of the possible dimensions of the rectangle. When given a fixed perimeter, students will be able to determine all possible areas. 5. Students will display and interpret data in multiple ways. 6. Students will explore data and interpret data.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Informational Texts:
• **Informational Books:**
  ○ Multiplication and Division Books
  ○ Sir Cumference and the Isle of Immeter
• **Media:**
  ○ Factorize
  ○ Shape Explorer
  ○ Math Clock
 	
Online Resources / Websites:

- MLC: Work Pace Sentence Frames
- MLC App: Number Pieces App
- MCL App: Partial Product Finder
- MCL: Strategies for Multiplication posters
- Game: Arithmetic Four
- Game: Fractris
- Game: Zoo Designer
- Factor Game
- Coloring in Remainders

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Area:** the total number of square units needed to cover a two-dimensional surface. **Array:** the total number of square units needed to cover a two-dimensional surface. **Centimeter (cm):** the total number of square units needed to cover a two-dimensional surface. **Data:** items of information; may include facts, numbers, or measurements. **Decimal:** relating to powers of 10; also, a fraction with a denominator that is a power of 10, often expressed using digits and a decimal point. **Dimension:** the length, width, or height of a figure. **Divide:** to break or split into equal parts; to determine how many times one number goes into another. **Dividend:** the number that will be divided in a division problem. **Divisor:** the number in a division problem that divides the dividend. **Equation:** a mathematical statement asserting that two quantities have the same value. **Equivalent Fractions:** two or more different fractions that represent the same quantity. **Equivalent Ratio:** **Factor:** a whole number that divides evenly into another number. **Foot (ft.):** a customary unit of length equal to 12 inches. **Fraction:** a number expressed as some number of equal parts of a whole. **Half:** one part when a number, shape, or set is divided into exactly two equal parts. **Hexagon:** a two-dimensional (flat) shape with 6 sides.

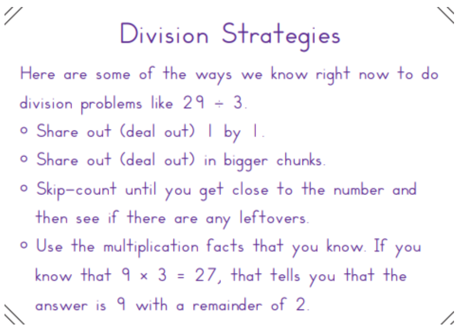
Inch (in.): a customary unit of length equal to 1⁄12 of a foot.
Kilometer (km): a metric unit of length equal to 1,000 meters or about 0.62 mile.
Line Plot: a horizontal number line that uses markings (such as an X or a dot) to show data points above their values on the line.
Median: the middle value of an ordered set of numerical data; in a set with an even number of data points, the median is the average of the two middle points.
Meter (m): a metric unit of length equal to 100 centimeters or about 39 inches.
Mile (mi.): a customary unit equal to 5,280 feet.
Mode: the value (or values) that appear most often in a set of data; there may be no mode, one mode, or multiple modes in a single set of data.
Multiple: a number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3.
Multiply: to find the product of.
Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference.
Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array.
Quotient: the result or answer in division; the number of times one quantity goes into another.
Range: the difference between the greatest and least values in a data set.
Ratio Table: a model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
Rectangle: a two-dimensional (flat) shape with two pairs of parallel sides (4 sides total) and 4 right angles.
Remainder: the number left over when one whole number is divided by another whole number.
Rhombus: a two-dimensional (flat) shape with 4 congruent sides.
Trapezoid: a two-dimensional (flat) shape with 4 sides, exactly 1 pair of which are parallel.
Triangle: a two-dimensional (flat) shape with 3 sides.
Unit: another name for 1 (the units' column is the same as the ones column); also a standard amount in which attributes (length, duration, mass) can be measured and quantified.
Whole Number: a number such as 0, 1, 2, 3; one of the positive integers or 0.
Yard (yd.): a customary unit of length equal to 3 feet or 36 inches.

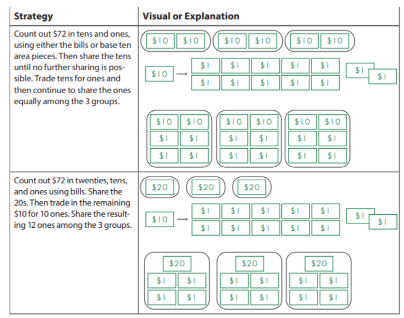
Learning Plan

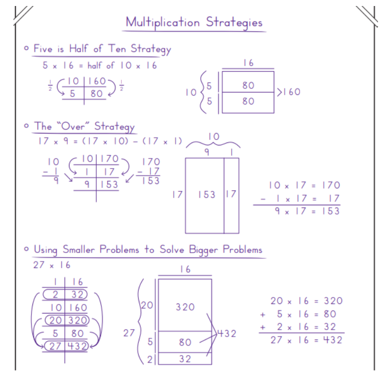
The instruction in Unit 6 is designed to help students understand, in ways that are both deep and robust, the many connections between multiplication and division. Each module in the unit is rich with opportunities to model and solve problems, share, and explain strategies, play games, and apply computational skills and concepts in a variety of contexts.

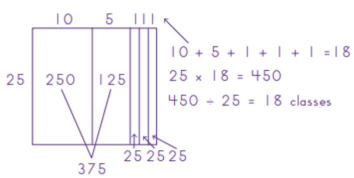
Learning Tasks Per Week (Including Instructional Strategies)

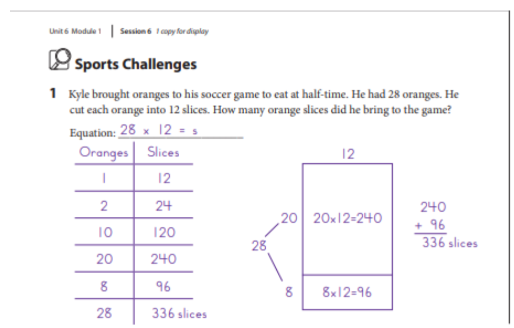
Week One: Multiplication & Division Strategies: Unit 6 opens with a review of some of the division strategies students developed earlier in the year. Students then solve and discuss a set of division problems that move beyond the basic facts. Sessions 3 and 4 focus on multiplication strategies, while Sessions 5 and 6 bring multiplication and division together as students discover that they can use the same models for both operations. The module ends with an emphasis on the importance of choosing strategies based on the numbers involved in the problems.



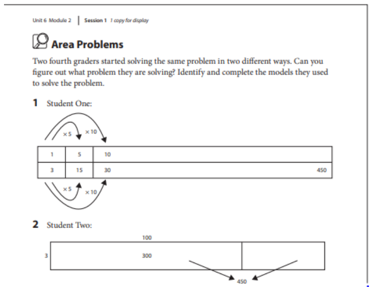


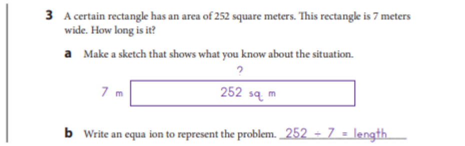


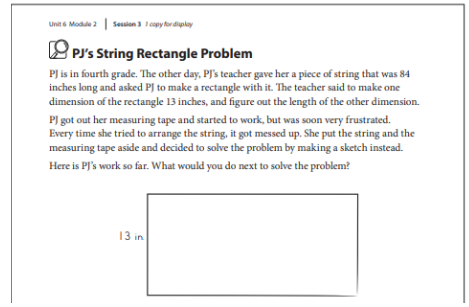


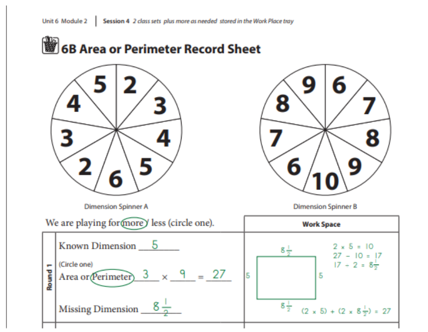


Week Two: Revisiting Area & Perimeter: In this module, students revisit and extend their understanding of area and perimeter. They focus on the role division plays in area and perimeter problems. Students spend one session finding the unknown dimension in problems where they know the area and one dimension. They spend two more sessions finding the unknown dimension in problems where they know the perimeter and one dimension. They discuss strategies for solving both types of problems during math forums and use these strategies when playing Area or Perimeter, a new Work Place game.

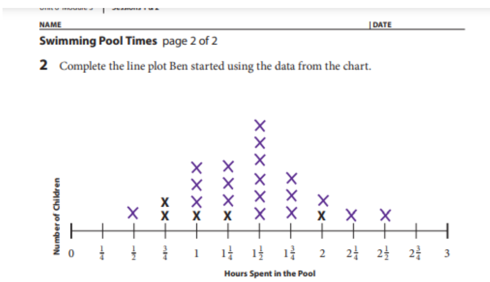


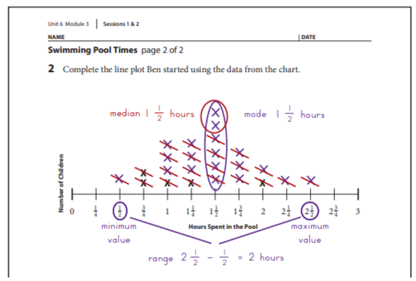


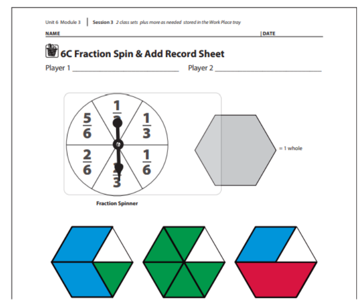




Week Three: Line Plots, Fractions & Division: In Module 3, the focus shifts from multiplication and division to collecting and representing data measured in fractions of a unit on a line plot. As students work with line plots during the first three sessions, they solve problems that involve addition and subtraction of fractions using the line plot data. The last two sessions in the module close the loop, as students solve division problems with remainders, using fractions and decimals in the process.



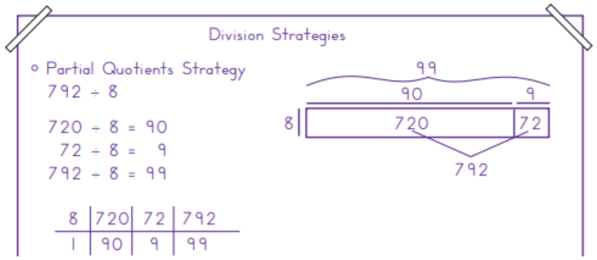


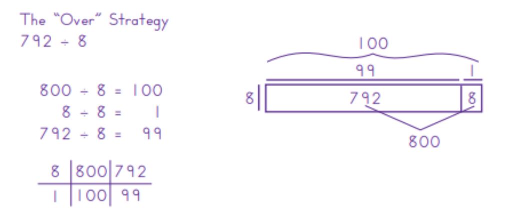


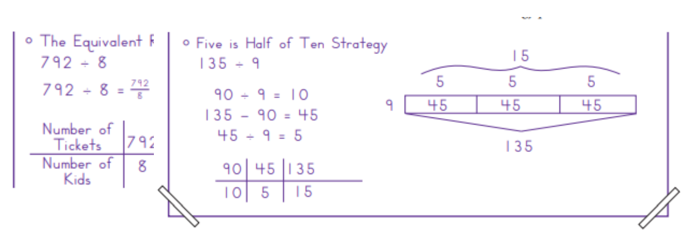
Strategy	Equations		Other Representations
Partial Products using multiplication to build up to the dividend	8 × ? = $1.60 8 × $0.10 = $0.80 $0.80 + $0.80 = $1.60, so 8 × $0.20 = $1.60	Ratio Table	× 2 $0.10 | $0.20 $0.80 | $1.60 × 2
Partial Quotients breaking the dividend into chunks that are easier to divide	$1.60 ÷ 8 = ? $1.60 = $0.80 + $0.80 $0.80 ÷ 8 = $0.10, so $1.60 ÷ 8 = $0.20	Fraction & Decimal Form	$\frac{1.60}{8} = \frac{0.80}{8} + \frac{0.80}{8}$ = 0.10 + 0.10 = 0.20
Equivalent Ratios		Ratio Table	Dollars | $1.60 | $0.80 | $0.40 | $0.20 People | 8 | 4 | 2 | 1

Week Four: More Division: Module 4 provides additional opportunities for students to hone their division skills. The module opens with a problem string that reinforces the connection between division and equivalent ratios. Then students learn a new Work Place game that provides practice dividing with and without remainders. The second session features a wrap-up, as students solve division problems, share strategies, and work together to create a class chart for division, analogous to the multiplication strategies chart they generated in the first module of this unit. Finally, students take the Unit 6 Post-Assessment.

Problems	Sample Strategies & Recording	Connections
How much money would each person get if 10 people shared \$20? \$20 ÷ 10	Most fourth graders are familiar enough with money context to know the answer without a lot of figuring. Record the answer shared by your volunteers, and record it in the form of a fraction as well. \$20 ÷ 10 = \$2 $\frac{20}{10} = 2$	If the dividend doubles, but the divisor stays the same, the quotient doubles.
What if 10 people shared \$40? \$40 ÷ 10	\$40 ÷ 10 = \$4 $\frac{40}{10} = 4$	
What if 5 people shared \$20? \$20 ÷ 5	\$20 ÷ 5 = \$4 $\frac{20}{5} = 4$ Once students have shared their solutions and you have recorded the equations above, discuss the fact that $^{40}/_{10}$ and $^{20}/_{5}$ are equivalent ratios. Reinforce this by writing the two equations below side by side on the board, and then writing the ratios side by side. \$40 ÷ 10 = $\frac{40}{10} = 4$ and \$20 ÷ 5 = $\frac{20}{5} = 4$ $\frac{40}{10} = \frac{20}{5}$	In this problem, the dividend and the divisor are both half of those in the second problem. When that is the case, the quotient remains the same.
What if 20 people share \$20? \$20 ÷ 20	\$20 ÷ 20 = \$1 $\frac{20}{20} = 1$	**Big Idea** When the ratios involved in two division combinations are equivalent, their quotients are equal. After students have solved both of these problems, note with them that $^{20}/_{20} = {}^{10}/_{10}$ because the dividend and the divisor have both been halved.
What if 10 people share \$10? \$10 ÷ 10	\$10 ÷ 10 = \$1 $\frac{10}{10} = 1$	
What if 10 people share \$5? \$5 ÷ 10	Look for at least one student who solves this problem by reasoning that if each person got \$1 in the previous problem, each person will get \$0.50 in this situation because the same number of people (10) are sharing half the amount of money as in the preceding problem. \$5 ÷ 10 = \$0.50 $\frac{5}{10} = 0.50 = 0.5$	In this problem, the same number of people share half the amount of money as they did in the previous problem. When this is the case, each person's share is halved.







Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)

Unit 6

Young Mathematicians at Work: Constructing Multiplication and Division by Catherine Twomey Fosnot, Maarten Dolk

Learning to Think Mathematically with the Ratio Table by Jeff Frykholm

Sir Cumference and the Isle of Immeter (Math Adventures) by Cindy Neuschwander

- When students understand the underlying structure that makes certain strategies viable and generalizable, they are better equipped to develop fluency with strategies for multi-digit multiplication.
- When students solve problems that involve repeating the same kind of reasoning, they begin to recognize patterns that help them develop generalized methods for completing certain kinds of calculations.
- Students make sense of problems and persevere in solving them when they use the partially completed solutions to work backward to determine what the problem was and then solve it. In carefully examining the incomplete solutions, students must make sense of the relationships among the numbers and think about what information is known and what information needs to be determined.
- Students use appropriate tools strategically when they use string to model and measure perimeter. The string is appropriate for several reasons. Because it is cut to a length exactly equal to the total perimeter, it constrains students' work in a meaningful way. Using a length of string also reinforces the crucial understanding that perimeter is a form of linear measurement that describes the distance around a figure.
- Creating line plots and other graphs is one way to model with mathematics. In this case, the line plot creates a complete picture that allows students to analyze the data and draw conclusions. The line plot incorporates a number line on its x-axis, which also makes it a helpful and familiar model for the fractional data represented on it.
- Students will reason abstractly and quantitatively as they solve these problems, which involve dividing with money. Some students will move comfortably between representing their thinking with numbers and thinking about those numbers in the context of the problem. Others will need the support of the money value pieces, which represent the quantities explicitly, to make sense of the quantities and divide with them.
- Students look for and make use of structure in their ratio tables to play for the lowest remainder. This builds their fluency with division, as well as their understanding of multiples and remainders.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

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Challenge:
- Ask students to create their own version of a work place and teach another pair of students how to play
- See "Game Variations" in work place guides
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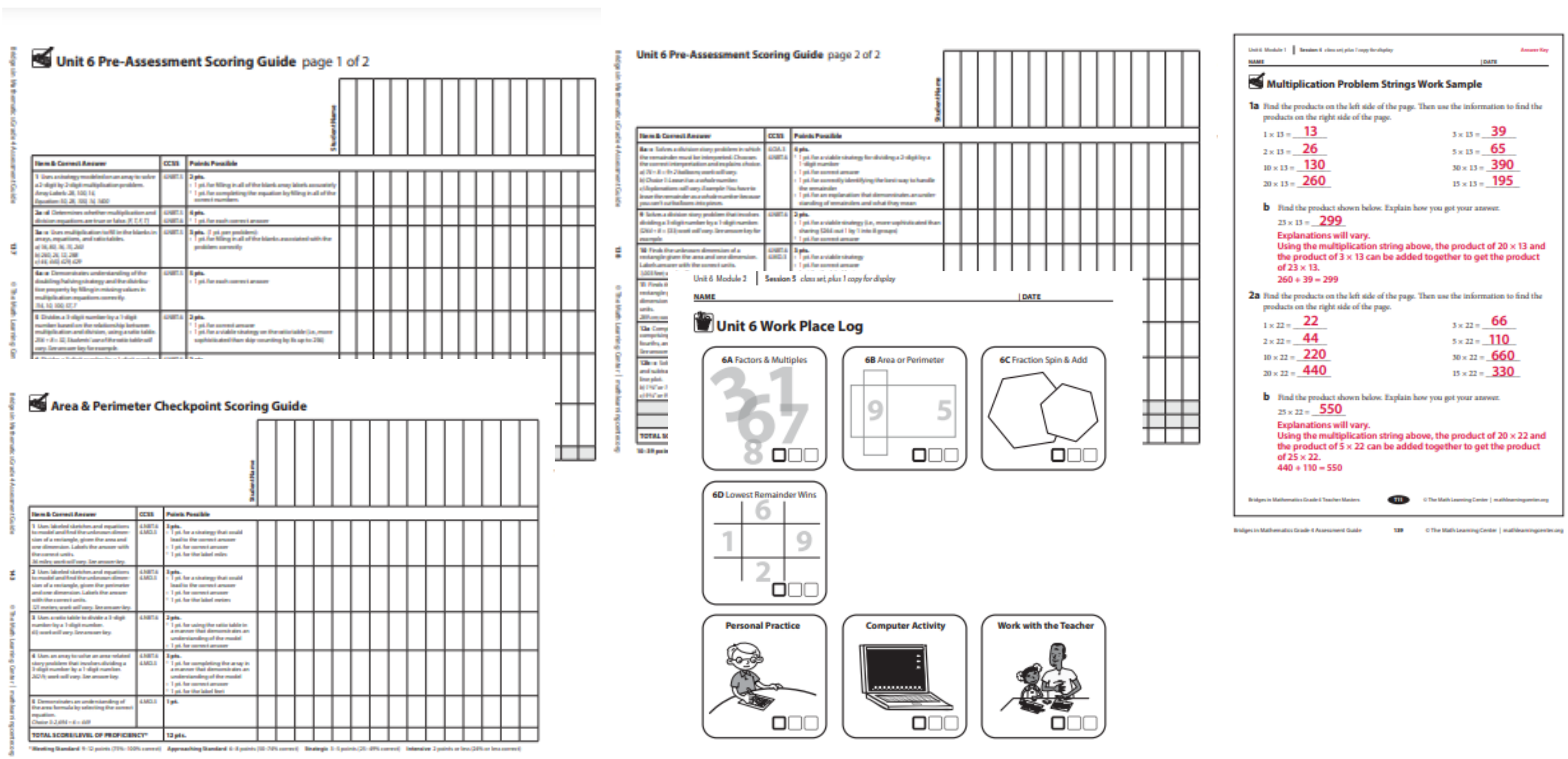
Assessments

Include an overview of authentic assessments

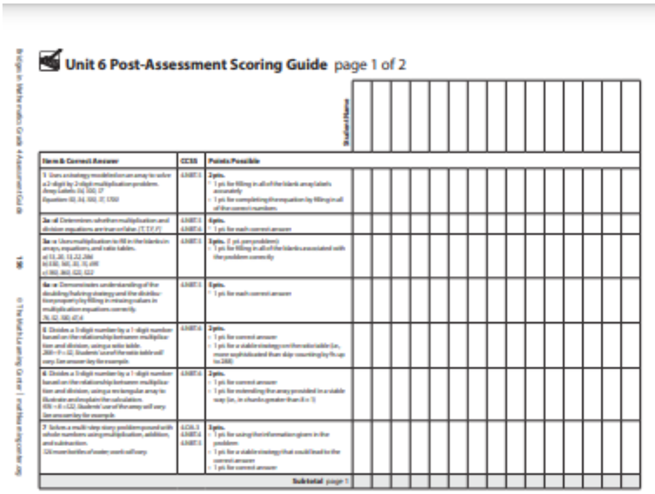
Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 6 Pre Assessment
- Multiplication Problem Strings Work Sample
- Area and Perimeter Checkpoint
- Work place games

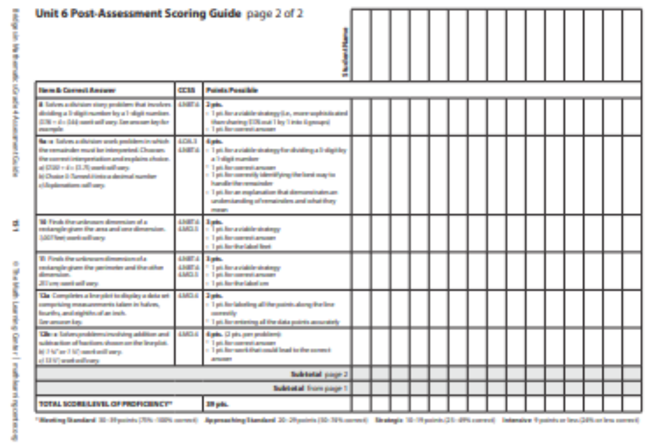


Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 6 Post Assessment



Unit 6 Post-Assessment Scoring Guide page 1 of 2



Unit 6 Post-Assessment Scoring Guide page 2 of 2

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 7: Reviewing & Extending Fractions, Decimals & Multi-Digit Multiplication
Pacing	4 Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices
(Practices in bold are emphasized in this unit)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:
4.OA.3 Solve multi-step story problems involving only whole numbers, using addition, subtraction, multiplication, and division.
4.OA.3 Write equations with a letter standing for an unknown quantity to represent a multi-step story problem.
4.OA.3 Assess the reasonableness of answers to multi-step story problems using mental computation, rounding, or other estimation

strategies.
4.NBT.5 Multiply a 2 or 3-digit whole number by a 1-digit whole number using strategies based on place value and the properties of operations.
4.NBT.5 Multiply two 2-digit numbers using strategies based on place value and the properties of operations.
4.NBT.5 Use equations, rectangular arrays, or an area model to explain strategies for multiplying with multi-digit numbers.
4.NF.1 Recognize equivalent fractions; use a visual model to explain why a fraction a/b is equivalent to a fraction (n × a)/(n × b).
4.NF.1 Generate a fraction equivalent to fraction a/b by multiplying the numerator (a) and denominator (b) by the same number.
4.NF.2 Compare two fractions with different numerators and different denominators.
4.NF.2 Use the symbols >, =, and < to record comparisons of two fractions with different numerators and different denominators.
4.NF.2 Explain why one fraction must be greater than or less than another fraction.
4.NF.5 Express a fraction with denominator 10 as an equivalent fraction with denominator 100.
4.NF.5 Add a fraction with denominator 10 to a fraction with denominator 100 by rewriting the first fraction as an equivalent fraction with denominator 100.
4.NF.6 Write fractions with denominator 10 or 100 in decimal notation.
4.NF.7 Compare two decimal numbers with digits to the hundredths place.
4.NF.7 Use the symbols >, =, and < to record comparisons of two decimal numbers with digits to the hundredths place.
4.NF.7 Explain why one decimal number must be greater than or less than another decimal number.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Select the best operation or group of operations to solve a multi-step problem. 2. Use estimation strategies to assess reasonableness of answers.	1. Students use and discuss various strategies for solving word problems using all four operations. 2. Estimation strategies include identifying when estimation is appropriate, determining the level of accuracy needed, selecting the appropriate method of estimation, and verifying solutions or determining the reasonableness of situations using various estimation strategies.

3. Use strategies to solve multi-digit multiplication problems.	3. Students should be able to apply their understanding of place value and various forms of a number to compute products. Students will also use area models, partial products and properties of operations to solve multiplication problems.
4. Show and explain fraction equivalence.	4. Use area and length fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size.
5. Compare two fractions with the denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100 and use the benchmark fractions 0, ½ and 1 whole to compare fractions.	5. Different numerators and denominators determine size.
6. Show and explain fraction equivalence.	6. Use area and length fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size.
7. Use decimal notation to represent fractions.	7. Students should have ample opportunities to explore and reason about the idea that a number can be represented as both a fraction and a decimal. This standard establishes the connection that a fraction that has been equally partitioned into 10 or 100 equal parts (10th and 100ths) can also be written as a decimal. Students make connections between fractions with denominators of 10 and 100 and the place value chart.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Can you multiply two 2-digit numbers using a variety of	1. Students should be able to apply their understanding of

strategies?	place value and various forms of a number to compute products. Students will also use area models, partial products and properties of operations to solve multiplication problems.
2. Can you make good estimates for the answers to large multiplication problems?	2. Estimation skills include identifying when estimation is appropriate, determining the level of accuracy needed, selecting the appropriate method of estimation, and verifying solutions or determining the reasonableness of situations using various estimation strategies.
3. Can you write (or choose) equations to represent multi-step problems?	3. Students need to be able to figure out and show the best mathematical thinking for solving word problems.
4. Can you come up with fractions that are equivalent to one another and compare fractions that have different numerators and different denominators, and explain why one must be greater than another?	4. Explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b) by using visual fraction models and compare two fractions with different numerators and different denominators by creating common denominators or numerators or using models, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole.
5. Can you compare decimals to the hundredths place and write fractions with denominators 10 and 100 as decimal numbers?	5. Use decimal notation for fractions with denominators 10 or 100. *(i.e. Rewrite 0.62 as 62/100 ; describe a length as 0.62 meters; locate 0.62 on a number line diagram.)*
6. Can you add two fractions with unlike denominators (tenths and hundredths) by rewriting the tenths as hundredths?	6. Students make connections between fractions with denominators of 10 and 100 and the place value chart. By reading fraction names, students say 32/100 as thirty-two hundredths and rewrite this as 0.32 and then use that information to add.

Resources
Student Technology Integration and [Correspondence to ISTE Standards] when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Informational Texts:
• **Informational Books:**
  ○ Fraction and Decimals Booklist
  ○ Young Mathematicians at Work
  ○ Amazon Booklist
• **Media:**
  ○ Arrays, Multiplication and Division
 	
Online Resources / Websites:
• MLC App: Fractions App
• MLC App: Number Line
• Game: Concentration
• Game: Dirt Bike Comparing Fractions
• Game: Factris
• Game: Pecking Order

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Area:** the total number of square units needed to cover a two-dimensional surface. **Area Model of Multiplication:** a model in which two numbers being multiplied are represented by the dimensions of a rectangle, and their product is represented by the area of the rectangle. **Array:** an arrangement consisting of equal rows and equal columns.

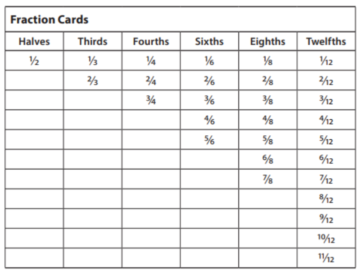
Centimeter (cm): a metric unit of length equal to $1/1$ of a meter or about $2/5$ of an inch.
Dimension: the length, width, or height of a figure.
Divide: to break or split into equal parts; to determine how many times one number goes into another.
Equation: a mathematical statement asserting that two quantities have the same value.
Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation.
Even Number: a number that can be exactly divided by 2; all even numbers end with 0, 2, 4, 6, or 8.
Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs.
Foot (ft.): a customary unit of length equal to 12 inches.
Inch (in.): a customary unit of length equal to $1/12$ of a foot.
Kilometer (km): a metric unit of length equal to 1,000 meters or about 0.62 miles.
Meter (m): a metric unit of length equal to 100 centimeters or about 39 inches.
Mile (mi.): a customary unit equal to 5,280 feet.
Millimeter (mm): a metric unit of length equal to one-thousandth of a meter and one-tenth of a centimeter.
Multiply: to find the product of.
Odd Number: a number that cannot be evenly divided by 2; all odd numbers end with 1, 3, 5, 7, or 9.
Operation: any procedure—such as addition, subtraction, multiplication, and division—in which numbers are acted upon according to a set of rules.
Parentheses: curved marks used to group mathematical symbols.
Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement.
Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference.
Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array.
Sum or Total: the result of adding two or more numbers.
Variable: a quantity that can change or have different values; also, a symbol (often a letter) that stands for a variable.
Yard (yd.): a customary unit of length equal to 3 feet or 36 inches.

Learning Plan

Unit 7 reviews and extends skills and concepts in several areas that are foundational to the major work of fourth grade. In the first two modules, students refine their skills at recognizing and generating equivalent fractions, as well as comparing fractions with denominators using visual models, benchmarks such as one half, and rewriting to share common denominators. In the latter half of the unit, students review some of the strategies they have developed for multi-digit multiplication over the year and explore the *standard multiplication algorithm.*

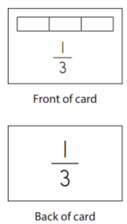
Learning Tasks Per Week (Including Instructional Strategies)

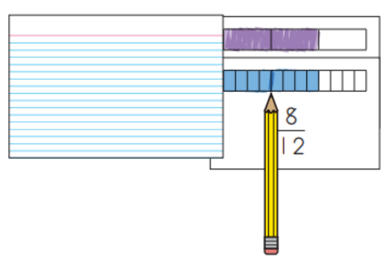
Week One: Comparing Fractions & Writing Equivalent Fractions: Students use bar models and number lines to represent, compare, and order fractions with unlike denominators. After a careful review of equivalent fractions, students are challenged to compare pairs of fractions with denominators that are not factors or multiples of each other, such as 4/5 and 5/6 or 3/8 and 4/12. Because some of these pairs are too close to compare visually with any accuracy, they invite strategies that involve finding common denominators.

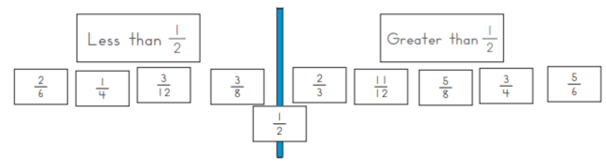


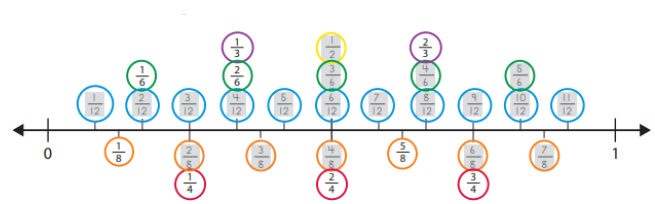
Fraction Cards

Halves	Thirds	Fourths	Sixths	Eighths	Twelfths
½	⅓	¼	⅙	⅛	1/12
	⅔	2/4	2/6	2/8	2/12
		¾	3/6	3/8	3/12
			4/6	4/8	4/12
			⅚	⅝	5/12
				6/8	6/12
				⅞	7/12
					8/12
					9/12
					10/12
					11/12

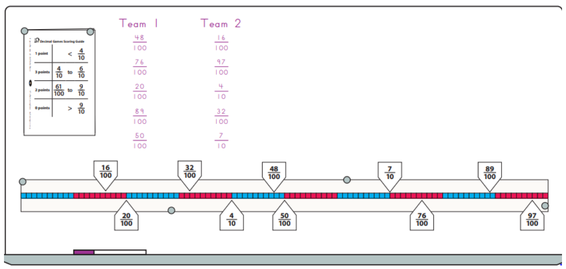


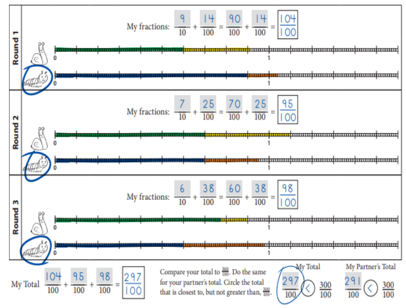




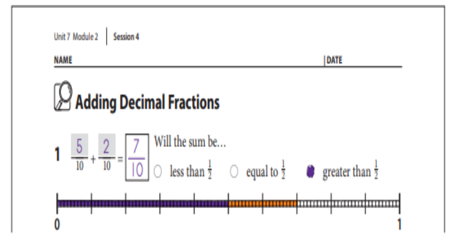


Week Two: Decimals & Decimal Fractions: After reviewing the hundredths grid, students work in pairs to cut a grid apart and rearrange the columns to form a single meter-long strip. They use their decimal strips to represent, compare, order, and add fractions with denominators 10 and 100.

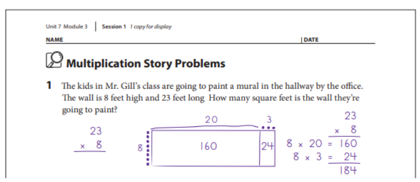




$$\frac{3}{10} + \frac{75}{100} = \frac{30}{100} + \frac{75}{100} = \frac{105}{100}$$

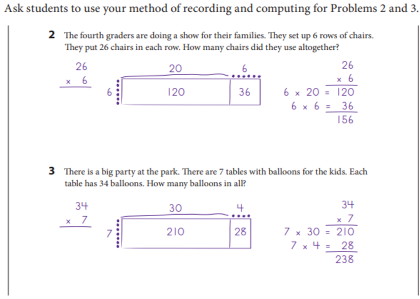


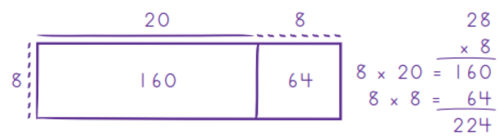
Week Three: Introducing the Standard Multiplication Algorithm: In this module and the next, students review strategies for solving single- and double-digit multiplication combinations, with a particular focus on the use of the area model and partial products. In the second session, the teacher introduces the standard algorithm for multiplying 2- and 3-digit by 1-digit numbers. In the third session, students consider when the standard algorithm is best used and when other strategies might make more sense. Sessions 4 and 5 lay the groundwork for an introduction to the standard algorithm for 2-digit by 2-digit multiplication.

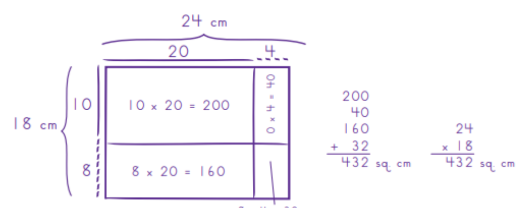


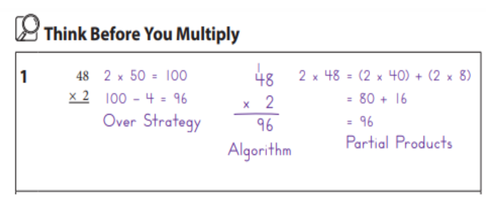
Repeat steps 2–5 with the other two problems.

Ask students to use your method of recording and computing for Problems 2 and 3.

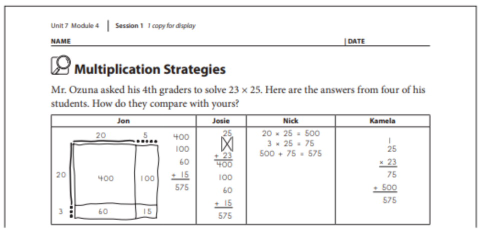


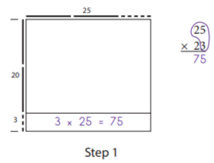


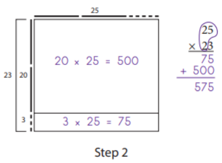


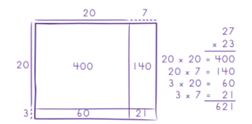


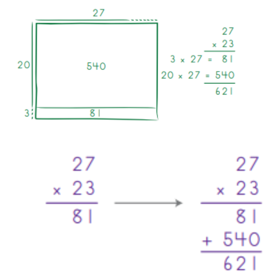
Week Four: Extending the Standard Multiplication Algorithm: The first three sessions in this module parallel some of the instruction in the previous module, as students are introduced to the standard algorithm for double-digit multiplication. In the third session, students review and evaluate some of the multiplication methods and strategies they have investigated over the past couple of weeks, including the standard algorithm. The module ends with a unit post-assessment.











Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)

  Unit 7

  Young Mathematicians at Work: Constructing Multiplication and Division by Catherine Twomey Fosnot, Maarten Dolk

- When students consider the fractions in only numeric form, they are pressed to reason in abstract ways. When students turn the cards over, they can use the fraction bars to reason quantitatively. For some students, this shift will support the abstract reasoning they were employing to compare the fractions. For others, the visual support will be necessary for them to make comparisons. Shifting between abstract and quantitative reasoning makes this activity accessible to a range of learners, and employing both kinds of reasoning helps all students deepen their understanding of the relationships among fractions.
- If students are confused, help them find ways to articulate what they do understand and identify where they encounter confusion. Then invite others to construct explanations that can help resolve that confusion. When students make assertions, whether they are correct or incorrect, ask them to justify those assertions with a viable argument. For example, you might invite them to show elements of the model that support their ideas and then invite their classmates to evaluate their reasoning. Such conversations deepen all students' understanding of insights and accurate observations, and they also help to draw out and resolve misconceptions.

- When you invite students to look for and explain patterns in the repetitive process of generating equivalent fractions for a single fraction, you are giving them the chance to look for and express regularity in repeated reasoning. It is through this repetition, and the search for patterns and rules within that repetition, that students come to understand that any time they multiply the numerator and denominator of a given fraction by the same number, the result is an equivalent fraction.
- Use students' facial expressions and body language as clues signaling possible confusion. Invite a student who looks puzzled or suddenly discouraged or disengaged to share his thinking. If necessary, restate and clarify the misconception. Then encourage others to construct viable explanations and arguments that can help resolve the issue. Students may be especially eager to make and justify assertions in the context of mildly competitive games such as this one.
- Using contextual story problems and visual models, this module creates opportunities for students to reason quantitatively and abstractly as they develop an understanding of and fluency with the standard multiplication algorithm.
- When they see and understand this structure, they bring their understanding of the distributive property and of place value to bear on their work with the algorithm.
- Students construct viable arguments and critique the reasoning of others, not only when they evaluate the accuracy of their strategies and answers, but when they discuss what methods they selected to solve each problem. Discussions like these prompt students to think about how the strategies are suited to the numbers as well as how different strategies are related to each other, all of which enhances their understanding of and fluency with multi-digit multiplication.

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The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
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Differentiation

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Support: ● When applicable give students smaller numbers to practice the strategies ● When working with larger numbers, give students the addition/subtraction charts to support basic fact recall ● See “Game Variations” in work place guides ● See “Assessment and Differentiation” in work place teacher masters
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Assessments

Include an overview of authentic assessments

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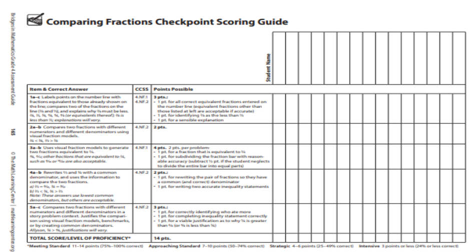
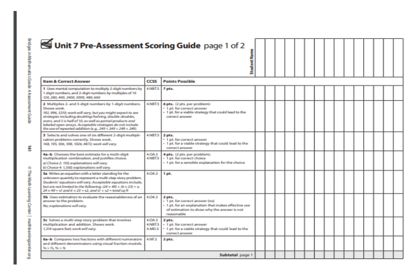
- Unit 7 Pre-Assessment
- Work Place games
- Comparing Fractions Checkpoint
- Problems and Equations Checkpoint


Comparing Fractions Checkpoint Scoring Guide


Unit 7 Pre-Assessment Scoring Guide page 1 of 2

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Unit 7 Pre-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
7a–b Uses visual fraction models to generate two fractions equivalent to [illegible]. *[illegible]; other fractions that are equivalent to [illegible], such as [illegible] or [illegible] are also acceptable.*	4.NF.1	**4 pts.** 2 pts. per problem: • 1 pt. for a fraction that is equivalent to [illegible] • 1 pt. for subdividing the fraction bar with reasonable accuracy (subtract ½ pt. if the student neglects to divide the entire bar into equal parts)	
8a–b Compares two fractions with different numerators and different denominators by rewriting them with common denominators. *a) [illegible] b) [illegible] Note: Answers shown use lowest common denominators, but others, e.g., twelfths or twenty-fourths, are acceptable.*	4.NF.2	**4 pts.** 2 pts. per problem: • 1 pt. for rewriting the pair of fractions so they have a common (and correct) denominator • 1 pt. for using the information to correctly compare the two fractions	
9a–c Compares two decimals with digits to the hundredths place. >, <, <	4.NF.7	**3 pts.**	
9d–f Compares two fractions with different numerators and different denominators (tenths & hundredths). <, <, >	4.NF.2	**3 pts.**	
10a–c Compares two fractions with different numerators and different denominators in a story problem context. Justifies the comparison using visual fraction models, benchmarks, or by creating common denominators. *Lupe, [illegible], justifications will vary.*	4.NF.2	**3 pts.:** • 1 pt. for correct answer • 1 pt. for correct inequality statement • 1 pt. for a viable justification as to why [illegible] is less than [illegible] (or [illegible] is greater than [illegible])	
11 Labels two points along a decimal strip with fractions with denominators 10 and 100 and decimals (tenths and hundredths). *[illegible], 0.2, and 0.20; [illegible], 0.7, and 0.70*	4.NF.5 4.NF.6	**2 pts.:** • 1 pt for each entirely correct response (2 fractions and 2 decimals)	
12 Adds a fraction with denominator 10 to a fraction with denominator 100 by rewriting the first fraction as an equivalent fraction with denominator 100; explains answer and includes a labeled sketch in the explanation. *Ari; explanations will vary, but must include labeled sketch.*	4.NF.5 4.MP.3	**3 pts.:** • 1 pt. for correct answer • 1 pt. for reasonable explanation for why [illegible] is [illegible] rather than [illegible] (and labeled sketch) • 1 pt. for accurate and well-labeled sketch demonstrating that [illegible]	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**48 pts.**	

12–48 points (25%–100%): Working at Tier 1 or Tier 2 Level **11 points or fewer (24% or less):** May need Tier 3 support to succeed with the work in Unit 7

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Problems & Equations Checkpoint Scoring Guide

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Uses mental computation to multiply 2-digit numbers by 1-digit numbers, and 2-digit numbers by multiples of 10 *270, 240, 200, 1800, 4000, 660, 840*	4.NBT.5	**7 pts.**	
2 Multiplies 2- and 3-digit numbers by 1-digit numbers. Shows work. *144, 1300, 1393; work will vary, but you might expect to see strategies including doubling/halving, overs, and 5 is half of 10, as well as partial products and labeled open arrays. Acceptable strategies do not include the use of repeated addition (e.g., 24 + 24 + 24 + 24 + 24 + 24).*	4.NBT.5	**6 pts.** (2 pts. per problem): • 1 pt. for correct answer • 1 pt. for a viable strategy that could lead to the correct answer	
3a Chooses the equation that best represents a multi-step story problem. *[Choice 3: (7 × 48) + 6 = c]*	4.OA.3	**1 pt.**	
3b Chooses the best estimate for the answer to the multi-step story problem. *[Choice 2: 50 crayons]*	4.OA.3	**1 pt.**	
3c Evaluates the reasonableness of an estimate for the multi-step story problem. *No. Students' explanations will vary. Example: 100 is too high. 7 × 50 is 350, and if you divide that by 6, it's about 60.*	4.OA.3	**2 pts.** • 1 pt. for correct answer (no) • 1 pt. for a viable explanation as to why 100 is not the best estimate	
4a Writes an equation with a letter standing for the unknown quantity to represent a multi-step story problem. *Students' equations will vary. Acceptable equations include, but are not limited to the following: (11 × 24) – (26 × 3) = p, 11 × 24 – 26 × 3 = p, 11 × 24 – 78 = p, 264 – 26 × 3 = p, 264 – 78 = p.*	4.OA.3	**1 pt.**	
4b Uses estimation to evaluate the reasonableness of an answer to the problem. *No; explanations will vary. Example: 95 is too low. 10 × 24 = 240, and 240 – 75 is about 170.*	4.OA.3	**2 pts.** • 1 pt. for correct answer (no) • 1 pt. for a viable explanation as to why the answer is not reasonable	
4c Solves a multi-step story problem that involves multiplication and addition. Shows work. *186 pencils; work will vary.*	4.OA.3 4.NBT.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for a viable strategy that could lead to the correct answer	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**22 pts.**	

* **Meeting Standard** 17–22 points (75%–100% correct) **Approaching Standard** 11–16 points (50–74% correct) **Strategic** 6–10 points (25–49% correct) **Intensive** 5 points or less (24% or less correct)

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Unit 7 Post Assessment

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Unit 7 Post-Assessment Scoring Guide page 1 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
1 Uses mental computation to multiply 2-digit numbers by 1-digit numbers, and 2-digit numbers by multiples of 10. *160, 420, 300, 2400, 4000, 860, 990*	4.NBT.5	**7 pts.**	
2 Multiplies 2- and 3-digit numbers by 1-digit numbers. Shows work. *306, 1796, 1605; work will vary, but you might expect to see strategies including double-doubles, overs, and 5 is half of 10, as well as partial products and labeled open arrays. Acceptable strategies do not include the use of repeated addition (e.g., 449 + 449 + 449 + 449).*	4.NBT.5	**6 pts.** (2 pts. per problem): • 1 pt. for correct answer • 1 pt. for a viable strategy that could lead to the correct answer	
3 Selects and solves one of 6 different 2-digit multiplication problems correctly. Shows work. *286, 375, 748, 648, 1269, 6324; work will vary.*	4.NBT.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for a viable strategy that could lead to the correct answer	
4a–b Chooses the best estimate for a multi-digit multiplication combination, and justifies choice. *a) Choice 3: 200; Students' explanations will vary. Example: 29 is very close to 30, and 7 × 30 is 210. b) Choice 3: 2,000; explanations will vary. Example: This is almost like 40 × 50, and that's 2,000.*	4.OA.3 4.NBT.5	**4 pts.** (2 pts. per problem): • 1 pt. for correct choice • 1 pt. for a sensible explanation for the choice	
5a Writes an equation with a letter standing for the unknown quantity to represent a multi-step story problem. *Students' equations will vary. Equations include, but are not limited to the following: (48 × 25) – (24 × 12) = b, 48 × 25 = s and 24 × 12 = l, and s – l = the answer*	4.OA.3	**1 pt.**	
5b Uses estimation to evaluate the reasonableness of an answer to the problem. *No; explanations will vary.*	4.OA.3	**2 pts.** • 1 pt. for correct answer (no) • 1 pt. for a viable explanation as to why the answer is not reasonable	
5c Solves a multi-step story problem that involves multiplication and addition. Shows work. *912 more small beads; work will vary.*	4.OA.3 4.NBT.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for a viable strategy that could lead to the correct answer	
		Subtotal page 1	

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Unit 7 Post-Assessment Scoring Guide page 2 of 2

Item & Correct Answer	CCSS	Points Possible	Student Name
6a–b Compares two fractions with different numerators and different denominators using visual fraction models. *[illegible]*	4.NF.2	**2 pts.**	
7a–b Uses visual fraction models to generate two fractions equivalent to [illegible]. *[illegible]; other fractions that are equivalent to [illegible], such as [illegible] or [illegible] are also acceptable.*	4.NF.1	**4 pts.** 2 pts. per problem: • 1 pt. for a fraction that is equivalent to [illegible] • 1 pt. for subdividing the fraction bar with reasonable accuracy (subtract ½ pt. if student neglects to divide entire bar into equal parts)	
8a–b Compares two fractions with different numerators and different denominators by rewriting them with common denominators. *a) [illegible], b) [illegible] Note: Answers shown use lowest common denominators, but others, e.g., twenty-fourths, are acceptable.*	4.NF.2	**4 pts.** 2 pts. per problem: • 1 pt. for rewriting the pair of fractions so they have a common (and correct) denominator • 1 pt. for using the information to correctly compare the two fractions	
9a–c Compares two decimals with digits to the hundredths place. <, <, >	4.NF.7	**3 pts.**	
9d–f Compares two fractions with different numerators and different denominators (tenths & hundredths). >, <, >	4.NF.2	**3 pts.**	
10a–c Compares two fractions with different numerators and different denominators in a story problem context. Justifies the comparison using visual fraction models, benchmarks, or by creating common denominators. *Joe, [illegible], justifications will vary.*	4.NF.2	**3 pts.:** • 1 pt. for correctly identifying who chewed more • 1 pt. for correct inequality statement • 1 pt. for a viable justification as to why [illegible] is less than [illegible] (or [illegible] is greater than [illegible])	
11 Labels two points along a decimal strip with fractions with denominators 10 and 100 and decimals (tenths and hundredths). *[illegible], 0.1, and 0.10; [illegible], 0.6, and 0.60*	4.NF.5 4.NF.6	**2 pts.:** • 1 pt for each entirely correct response (2 fractions and 2 decimals)	
12 Adds a fraction with denominator 10 to a fraction with denominator 100 by rewriting the first fraction as an equivalent fraction with denominator 100; explains answer and includes a labeled sketch in the explanation. *Lupe. Explanations will vary, but must include labeled sketch.*	4.NF.5 4.MP.3	**3 pts.:** • 1 pt. for correct answer • 1 pt. for reasonable explanation as to why [illegible] is [illegible] rather than [illegible] (and labeled sketch) • 1 pt. for an accurate and well-labeled sketch demonstrating that [illegible]	
		Subtotal page 2	
		Subtotal from page 1	
TOTAL SCORE/LEVEL OF PROFICIENCY*		**48 pts.**	

* **Meeting Standard** 36–48 points (75%–100% correct) **Approaching Standard** 24–35 points (50–74% correct) **Strategic** 12–23 points (25–49% correct) **Intensive** 11 points or less (24% or less correct)

Westbrook Public Schools
Elementary Mathematics
Mathematics Curriculum, Grade 4

Subject(s)	Math
Grade/Course	Grade 4 / Math
Unit of Study	Unit 8: Playground Design
Pacing	4 Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices ***(Practices in bold are emphasized in this unit)*** 1. Make sense of problems and persevere in solving them. **2. Reason abstractly and quantitatively.** 3. Construct viable arguments and critique reasoning of others. 4. Model with mathematics. **5. Use appropriate tools strategically**. **6. Attend to precision.** 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. **Priority/Focus Standards:** **4.G.1** Identify points, lines, line segments, rays, and angles (right, acute, obtuse), parallel lines, and perpendicular lines in 2-D figures.

4.G.1 Draw right, acute, obtuse angles, parallel lines, and perpendicular lines. **4.MD.1** Express a measurement in a larger unit in terms of a smaller unit within the same system of measurement. **4.MD.1** Identify the relative sizes of units within a system of measurement. **4.MD.1** Record equivalent measurements in different units from the same system of measurement using a 2-column table. **4.MD.2** Solve story problems involving distance, liquid volume, intervals of time, mass, and money using addition, subtraction, multiplication, or division of whole numbers, fractions, or fractions. **4.MD.2** Solve story problems that involve expressing measurements given in a larger unit in terms of a smaller unit within the same system of measurement; use diagrams to represent measurement quantities. **4.MD.3** Apply the perimeter and area formulas for a rectangle to solve a problem. **4.MD.5** Identify an angle as a geometric figure formed where two rays share a common endpoint. **4.MD.6** Use a protractor to measure angles in whole degrees; sketch an angle of a specified measure. Supporting Standards: **4.MD** Describe what mean, mode, or range indicate about data. **4.MD** Determine the mean, mode, or range of a set of data comprising whole numbers, fractional numbers, or decimals. **4.MD** Display and analyze data using spreadsheet software.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. 2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in	1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr., min, sec. 2. Larger quantities can be expressed using smaller quantities. a. ex: 1 quart = 2 pints = 4 cups = 32 ounces

terms of a smaller unit. 3. Students will generalize their understanding of area and perimeter by connecting the concepts to mathematical formulas. These formulas should be developed through experience, not just memorization.	3. Understand why the formulas work. a. ex: find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.
4. Students explore an angle as a series of "one-degree turns."	4. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle.
5. Measure angles in whole number degrees using a protractor and sketch angles of specified measure.	5. Understand that a 360º rotation about a point makes a complete circle to recognize and sketch angles that measure approximately 90º and 180º. Extend this understanding and recognize and sketch angles that measure approximately 45º and 30º.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Can students use measurement and geometry skills to collect and display data?	1. Students analyze the data to make decisions about their playground design.
2. Can students create a design plan based on data and research?	2. Students research the cost of playground equipment, find the total cost, and create a final design that is fun and safe for all.
3. Can students use the information to create a scaled map of their designs, from which they build a scaled 3-D model?	3. Students use scale factors to make measurement conversions and draw a scaled map of their playground design and use their scaled maps to determine the

	dimensions of each of their playground items and then build 3-D models.

Resources
Student Technology Integration and Correspondence to ISTE Standards when Applicable: **Standard 1.5.C:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
Online Resources / Websites: ● Playground Spreadsheets ● Game: Zoo Designer

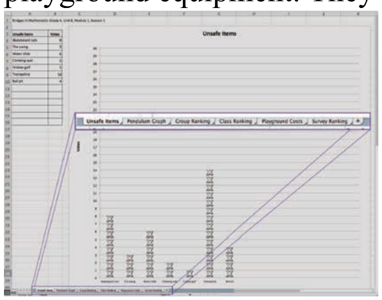
Vocabulary/Terminology
Vocabulary/Terminology with Definitions: **Angle:** the figure formed by 2 rays or line segments that share an endpoint; often measured in terms of the amount of rotation (expressed as some number of degrees) needed to superimpose one of those rays or line segments onto the other. **Bar Graph:** a graph that uses horizontal or vertical bars to show frequency of data. **Cup:** a customary unit of capacity equal to 8 fluid ounces. **Gram (g):** a metric unit of mass equal to one thousandth of a kilogram or about the weight of a standard paperclip. **Hexagon:** a two-dimensional (flat) shape with 6 sides. **Mass:** a measure of the amount of matter in an object measured in grams, kilograms, etc. **Mean:** the sum of all numbers in a data set divided by the number of data points; typically called the "average". **Range:** the difference between the greatest and least values in a data set. **Trapezoid:** a two-dimensional (flat) shape with 4 sides, exactly 1 pair of which are parallel. **Variable:** a quantity that can change or have different values; also, a symbol (often a letter) that stands for a variable.

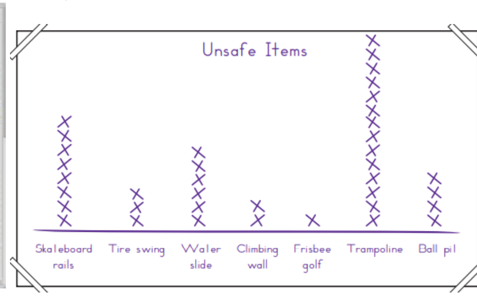
Learning Plan

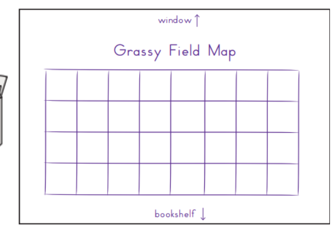
In this final unit of the year, students design and build scaled model playgrounds that incorporate simple machines. They investigate simple machines in playground equipment and conduct research to help them make decisions about safety issues. They then survey the school community to find the most important playground items to use in their designs and use graphs to visualize the data they collect. Students use the information to create a scaled map of their designs, from which they build a scaled 3-D model. They also discuss the needs of plants and plant a model grass field in preparation for finding the scaled measurements and cost for planting a much larger field. They work with mass, liquid volume, area, and perimeter during this portion of the unit. An optional Playground Model Showcase gives students an opportunity to prepare their work for sharing with friends and family members or students from other classrooms.

Learning Tasks Per Week (Including Instructional Strategies)

Week One: Introducing Playground Design: Students use measurement and geometry skills to collect and display data about playground equipment. They analyze the data to make decisions about their playground design.







Week Two: Making Decisions: Students measure their current playground, look for safety issues, survey other students in the school, and analyze their data. They choose the features of the new playground based on their analysis. They research the cost of playground equipment, find the total cost, and create a final design that is fun and safe for all.

The Current Playground

1 On a separate sheet of paper, draw a large sketch of the playground area. Show all the items on the playground, including seating, trash receptacles, drinking fountains, playground equipment and game areas.

2 Work with your team to take measurements of the playground using both metric and customary units. Record the measurements on your sketch.

- Measure the perimeter of the playground.
- Find the width and length of the large items (or of the space they need).

3 Look for safety issues in the playground and note them on your sketch.

- Is there enough room between the playground equipment?
- Is there proper surface material?
- Are there items that need to be replaced or changed?

4 Make a list of the simple machines you see on the playground. Use another piece of paper or your math journal if you need more room.

Playground Item	Simple Machine(s)

Emily

1st	basketball	4
2nd	play structure	3
3rd	swings	2
4th	sliding bar	1

Joseph

1st	play structure	4
2nd	basketball	3
3rd	climbing wall	2
4th	swings	1

Madeline

1st	climbing wall	4
2nd	wading pool	3
3rd	basketball	2
4th	play structure	1

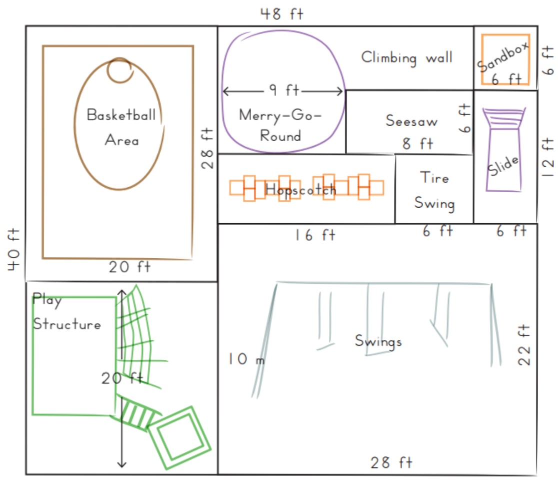
Our Team

Swings	2 + 1
Play Structure	3 + 4 + 1
Climbing Wall	2 + 4
Basketball	4 + 3 + 2
Sliding Bars	1
Wading Pool	3

Bridges in Mathematics Grade 4, Unit 8, Module 2, Session 4

Playground Costs			
Items	**Source 1 Price**	**Source 2 Price**	**Average Price**
climbing wall	$3,830.00	$5,642.00	$4,736.00
basketball	$245.00	$275.00	$260.00
play structure	$8,435.00	$7,900.00	$8,167.50
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
	$0.00	$0.00	$0.00
Total Cost			$13,163.50

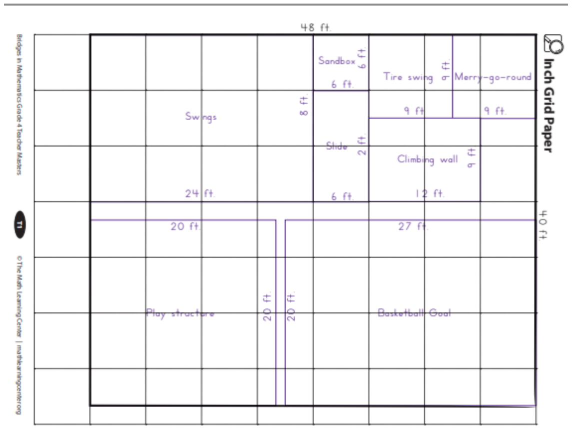
Week Three: Using Scale Models for Our Playground & Field: Students use scale factors to make measurement conversions and draw a scaled map of their playground design. They make line plots showing the impact of various water amounts on the height of grass in their model grassy field. Students then calculate the dimensions, area, mass of the soil, and water needs of the real field.



Scaled Dimensions

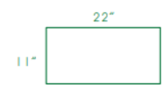
Scale Factor: 1 inch to 6 feet

Playground Items	Actual Dimensions		Scaled Dimensions	
	length	width	length	width
Playground Area	48′	40′	$48 \div 6 = 8''$	$40 \div 6 = \frac{40}{6} = 6\frac{2}{3}''$
Seesaw area	4′	15′	$4 \div 6 = \frac{4}{6} = \frac{2}{3}''$	$15 \div 6 = 2\frac{1}{2}''$
Swings	18′	24′	$18 \div 6 = 3''$	$24 \div 6 = 8''$
Merry-go-round area	9′	9′	$9 \div 6 = 1\frac{3}{6} = 1\frac{1}{2}''$	$9 \div 6 = 1\frac{1}{2}''$
Slide area	12′	6′	$12 \div 6 = 2''$	$6 \div 6 = 1''$
Play structure area	20′	20′	$20 \div 6 = \frac{20}{6} = 3\frac{1}{3}''$	$20 \div 6 = 3\frac{1}{3}''$
Sandbox	6′	6′	$6 \div 6 = 1''$	$15 \div 6 = 2\frac{1}{2}''$
Tire swing space	9′	9′	$9 \div 6 = 1\frac{1}{2}''$	$9 \div 6 = 1\frac{1}{2}''$
Climbing wall space	9′	12′	$9 \div 6 = 1\frac{1}{2}''$	$12 \div 6 = 2''$
Basketball goal	27′	20′	$27 \div 6 = \frac{27}{6} = 4\frac{1}{2}''$	$20 \div 6 = 3\frac{1}{3}''$

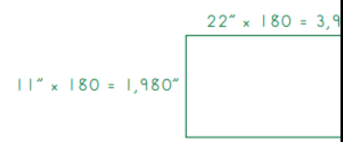


Our Model Field
(Dimensions 1/180 scale)
Dimensions: 11″ x 22″
(4 cartons x 8 cartons)
Area: 242 sq. in.
Mass of Soil: 5,760 g
Water (2 weeks): 92 cups

Our Real Field
Dimensions: 1,980″ x 3,960″
165 ft x 330 ft
Area: 54,450 sq. ft. (or 7,840,
Mass of Soil: 186,624 kg
Water (2 weeks): 186,300 gall



We know this field needs 5,760 grams of soil because we had 32 cartons with 180 g each.



The real field is 180 times longer and 180 wider than the little field. It's like a grid of l fields, 180 fields long and 180 fields wid The top corner of it would look like this.

180 x 180 = 32,400 so there are 32,400 little fields in the big field.
Or, to put it another way, the area of the big field is 32,400 times the area of the
So another way to calculate the area is to multiply 242 sq. in. by 32,400 to get 7,840
We can use that to calculate the amount of soil and water we need, too.
32,400 x 5,760 = 186,624,000 grams of soil for the big field! That's 186,624 kilo
That also means we need 32,400 x 92 cups of water for the big field.
That's 2,980,800 cups, which is 186,300 gallons of water for 2 weeks of wa

Week Four: Building Model Playgrounds: Students use their scaled maps to determine the dimensions of each of their playground items and then build 3-D models. They draw side views of the playground and equipment and identify the simple machines, geometric shapes, and angle measurements.

Session
Session 1 Planning Our Model Playground Students apply what they learned about simple machines and scale to plan a three-dimensional model of their playground design. Teams plan how they will work together to build the model, the time they will spend on each task, and the responsibilities of each team member.
Session 2 Building Our Model Playground In this session, students review their plans, make modifications if necessary, and then continue building their model playgrounds to scale.
Session 3 The Playground Model Showcase Students add the finishing touches to their playground models. Then they take a gallery walk to look at each other's work. An optional Playground Model Showcase gives them an opportunity to prepare their work for sharing with friends and family members or students from other classrooms.

Before Session 1, gather or ask families to send to school materials such as the following for use in model playground construction.

- toothpicks
- craft sticks or tongue depressors
- paper towel and toilet paper tubes
- straws
- plastic drink lids
- bottle corks
- plastic containers
- cardboard
- foam board
- newspapers
- cotton string
- yarn
- empty thread spools
- rubber bands
- copper wire
- pipe cleaners
- modeling clay
- foil
- stale marshmallows
- gumdrops
- twist ties

Interdisciplinary / Real World / Global Connections

- Connections to literature are woven throughout the units, lessons, and Number Corner. (Refer to "Literature Connections" in Resources.)
- Students use the line plot as evidence in their arguments. When students use data in this way, they see how mathematics can be used to construct viable arguments. When they critique the reasoning of others, they consider the data carefully and analyze whether it is being represented accurately in others' arguments.
- If you want to discuss soil ecology or gardening in more detail with your students, research soil composition before this session—particularly as related to lawn grasses. Spend a few minutes asking students about what they think a good soil is made of, whether soil that's ideal for grass differs from soil that is ideal for other plants, and how much water they think grass needs. Discuss the importance of soil composition for drainage and nutrients and speculate as to the amount of water that might support optimal growth.
- You can have students learn how to measure their soil in ounces using modeling clay or dough. We recommend that you do this if possible, so that students will have experience converting grams to ounces for future sessions. • Ask students how they can determine an ounce of clay if they know a box (or another portion you've prepared) is one pound. Have them share their thinking (e.g., one stick can be cut into four equal parts, each of which has a mass of 1 ounce; a one-pound portion can be divided into fourths, and each fourth can be divided into fourths again to get 16 ounces). • Provide one stick of clay and one

plastic knife to each group of six students. • Have students cut the sticks of clay into ounces and work together to find the mass of the soil. • Either ask students to approximate the mass in whole ounces or have them divide the clay into smaller pieces to find fractions of an ounce.

- • Over the course of the unit, students will need to work in small groups to visualize their data. Think about how student teams will work together at the computer for these activities. • Decide how students should name their spreadsheet files and where they will save them for easy retrieval. • If you're using software that allows multiple sheets to be kept in separate tabs within a file, we suggest that each student pair use one file for the entire unit and add a new sheet for each graph they'll do in this unit. Ask students to name the sheets with descriptive titles, such as Pendulum Graph.
- Learning to attend to precision involves thinking carefully about factors that can compromise precision and accuracy of measurements. Thinking about the data they have gathered in this way helps students measure more carefully and be more thoughtful in their analysis of that data.
- When students rank and evaluate the different pieces of playground equipment, they see how modeling with mathematics can help them represent situations and make decisions.
- Creating scale drawings of the playground designs is one way in which students can model with mathematics. Students must measure carefully and adhere to a consistent scale to create accurate models of the playground.
- Discuss conversion between metric and customary units. Have students make a table in their student journals, then record the dimensions for each item in both systems, working as a team to calculate conversions. (You might use 3.3 feet per meter as a conversion estimate.) Alternatively, do these conversions as a class, using a ratio table to record each set of measurements in customary units on one side and metric on the other. Students can then choose to use either meters or feet for their scale in making their scaled drawings in the next session.
- Different scales will have different advantages and disadvantages for the coming activities. A scale of 1 foot to 4 inches (1':4") produces relatively simple calculations but very large models. A scale of 1':8" has similar mathematical advantages while resulting in very small models, and students may find making such models to be difficult. A scale of 1':6" results in more challenging calculations and is likely to require that students estimate 1/3-inch measurements.
- Students attend to precision in measuring the grass and calculating how much water they used. When students perform their own experiments to answer questions they are interested in, they are motivated to be meticulous when handling their data.
- Students have a lot of freedom to select and use appropriate tools strategically. To do so, they must think carefully about their plans, the time they have, and the tools and materials that are available to them.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Differentiation

Disclosure: *The following chart indicates which sessions contain explicit suggestions for differentiating instruction to support or challenge students, as well as to make instruction accessible to ELL students. In addition, activities in this unit are specially designed to be open-ended enough for natural differentiation. Finally, Extensions in Modules 1–3 offer specific opportunities to engage students in need of further challenge.*

	Module 1						Module 2					Module 3						Module 4		
Session	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
Challenge													●			●	●			
Support				●	●			●		●					●	●				
ELL					●			●												

Assessments

Include an overview of authentic assessments

Disclosure: *There are no formal written assessments in Unit 8, but other assessment opportunities, including possible work* *samples, are noted throughout the unit; these opportunities are also noted in the chart below. You can use the Comprehensive Growth Assessment from the Assessment Guide and the fourth Number Corner Checkup for written assessment during this time.*

[Comprehensive Growth Assessment Scoring Guide]

Number Corner Assessments | **May Assessment**

Number Corner Checkup 4 Scoring Guide page 1 of 2

Item	CCSS	Points Possible	Student Name									
1 Determines the perimeter of a rectangle; adds mixed numbers with like denominators. *24 cm; work will vary.*	4.MD.3 4.NF.3c	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to correct answer										
2 Determines the area of a rectangle. *108 sq. meters; work will vary.*	4.MD.3	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to correct answer										
3 a–d Identifies relative sizes of metric units of measure. *Kilometers, centimeters, liters, grams*	4.MD.1	**4 pts.**										
4 a–c Fills in a two-column table to show measurement conversions. *1 (kg), 14,000 (g), 57 (kg)*	4.MD.1	**3 pts.**										
5 Solves a measurement story problem involving addition, and expresses measurements given in a larger unit as a smaller unit. *2,985 grams; work will vary.*	4.MD.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to correct answer										
6 Solves a measurement story problem involving a multiplicative comparison. *116 milliliters; work will vary.*	4.OA.2 4.MD.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to correct answer										
7 Solves a measurement story problem involving subtraction of mixed numbers. *$1 \frac{3}{8}$ inches; work will vary.*	4.NF.3c 4.NF.3d 4.MD.2	**2 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to correct answer										
8a–b Solves a measurement story problem involving multiplication of a fraction by a whole number. Writes an equation to represent the problem. *$\frac{8}{3}$ or $2 \frac{2}{3}$ yards; work will vary. Acceptable equations include $4 \times \frac{2}{3} = \frac{8}{3}$, $4 \times \frac{2}{3} = 2 \frac{2}{3}$, $8 \times \frac{1}{3} = \frac{8}{3}$, $2 \frac{2}{3} = 4 \times \frac{2}{3}$.*	4.NF.4b 4.NF.4c 4.MD.2	**3 pts.** • 1 pt. for the correct answer • 1 pt. for work that could lead to correct answer • 1 pt. for a multiplication equation that accurately represents the problem										
9a Completes a line plot to display a data set comprising measurements taken in halves, fourths, and eighths of an inch. *See answer key.*	4.MD.4	**2 pts.** • 1 pt. for completing the line plot accurately • 1 pt. for entering all the data points accurately										
9b Solves a problem involving subtraction of fractions shown on the line plot. *$2 \frac{1}{8}$ cm; work will vary.*	4.MD.4	**2 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to correct answer										
10 a–d Adds and subtracts fractions and mixed numbers; multiplies a fraction by a whole number. *4, $\frac{10}{8}$ or $1 \frac{2}{8}$ or $1 \frac{1}{4}$, $2 \frac{3}{6}$ or $2 \frac{1}{2}$, $4 \frac{8}{6}$ or $5 \frac{1}{3}$*	4.NF.3c 4.NF.4b	**4 pts.**										
		Subtotal page 1										

Number Corner Checkup 4 Scoring Guide page 2 of 2

Item	CCSS	Points Possible	Student Name									
11 Demonstrates an understanding of multiplying a fraction by a whole number. *T, F, T*	4.NF.4a	**3 pts.**										
12 Converts a fraction with denominator of 10 into a fraction with denominator of 100 in order to add tenths and hundredths. *$\frac{76}{100}$ (or $\frac{38}{50}$ or $\frac{19}{25}$); work will vary.*	4.NF.1 4.NF.5	**2 pts.** • 1 pt. for correct answer • 1 pt. for work that could lead to correct answer										
13 a–d Solves division problems with and without remainders. *13, 13 R3 or 13 $\frac{3}{4}$ or 13.75, 25, 25 R3 or 25 $\frac{3}{5}$. Work will vary.*	4.NBT.6	**4 pts.**										
14 Solves a division story problem with a remainder involving a situation in which the remainder can be split into fractional pieces. *4 $\frac{2}{4}$ or 4 $\frac{1}{2}$ pieces of pizza.*	4.OA.3 4.NBT.6	**3 pts.** • 1 pt. for correct answer • 1 pt. for a viable strategy that could lead to the correct answer • 1 pt. for demonstrating understanding of how to deal with the remainder										
15 Identifies the number of lines of symmetry in figures, and draws them in. *1, 0, 2 lines of symmetry. See answer key.*	4.G.3	**3 pts.**										
		Subtotal page 2										
		Subtotal from page 1										
TOTAL SCORE/LEVEL OF PROFICIENCY*		**43 pts.**										

* **Meeting Standard** 33–43 points (75%–100% correct) **Approaching Standard** 22–32 points (50–74% correct)
Strategic 11–21 points (25–49% correct) **Intensive** 10 points or less (24% or less correct)

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 1: Expressions, Equations, and Volume
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.OA.A.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

5.OA.A.2 Write simple expressions that record calculations with numbers and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.*

5.MD.C.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.

b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. 5.MD.C.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. 5.MD.C.5 Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: • Interpret numerical expressions without evaluating them	*Students will know/understand:* • Difference between an expression and an equation • Parentheses • Properties of multiplication
• Evaluate numerical expressions	• Use of parentheses • Multiples • Properties of multiplication
• Write expressions from words	• Numerical expressions • Properties of multiplication
• Solve multiplication problems involving two 2-digit numbers using multiple strategies	• Use of parentheses • Factors • Multiples • Properties of multiplication
• Use multiple strategies to evaluate multi-step expressions mentally	• Parentheses • Factors • Multiples • Properties of multiplication

• Divide and interpret remainders	• Division • Meaning of remainders
• Solve multi-step real world problems involving division with remainders	• Division • Meaning of remainders
• Calculate the volume of a rectangular prism	• Volume • Use of parentheses • Properties of multiplication
• Find dimensions of a rectangular prism given the volume	• Volume • Properties of multiplication
• Solve for an unknown value in a number sentence	• Properties of multiplication
• Identify factors of whole numbers and factor pairs for whole numbers between 1 and 100	• Factors

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are evaluating numerical expressions and solving equations useful?	1. Evaluating expressions and solving equations can be applied to real-world problem-solving involving volume.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
Informational Texts ***Informational Books:***

- Bridges in Mathematics Grade 5 Unit 1 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:
- IXL Lessons- Grade 5 Mathematics, Geometric Measurement
- Math Learning Center apps for Grade 5 Unit 1

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- Equation: a mathematical statement asserting that two quantities have the same value
- Factor: a number that divides evenly into another number
- Factor Pairs: the pairs of whole numbers that can be multiplied to produce a given whole number (e.g., 15 has two factor pairs: 1 and 15, and 3 and 5)
- Multiple: a number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3
- Multiply: to find the product of
- Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array
- Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs
- Dimension: the length, width, or height of a figure
- Evaluate: determine the value
- Rectangular Prism: a three-dimensional shape (solid) whose 6 faces are all rectangles.
- Volume: the total number of cubic units needed to fill a three-dimensional space

- <u>Base</u>: a face of a three-dimensional shape (solid), usually the face on which it stands
- <u>Area</u>: the total number of square units needed to cover a two-dimensional surface
- <u>Array</u>: an arrangement consisting of equal rows and equal columns
- <u>Associative Property of Multiplication</u>: the property by which the product remains unchanged no matter how the numbers being multiplied are grouped, so that $(a \times b) \times c = a \times (b \times c)$
- <u>Commutative Property of Multiplication</u>: the property by which the product remains unchanged no matter how the numbers being multiplied are ordered, so that $a \times b = b \times a$
- <u>Sum</u>: the result of adding two or more numbers
- <u>Divide</u>: to break or split into equal parts; to determine how many times one number goes into another
- <u>Estimate</u>: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation
- <u>Remainder</u>: the number left over when a whole number is divided by another whole number
- <u>Dividend</u>: the number that will be divided in a division problem
- <u>Divisor</u>: the number in a division problem that divides the dividend
- <u>Quotient</u>: the result or answer in division; the number of times one quantity goes into another
- <u>Parentheses</u>: curved marks used to group mathematical symbols ()

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students use volume to review and extend whole number multiplication. Students explore the concept of volume by arranging cubes to create rectangular prisms. Students apply the associative and commutative properties of multiplication to evaluate numerical expressions. Students connect multiplication and division using the area model and apply these strategies to divide 3-digit and 2-digit numbers.
Learning Tasks

Week One:

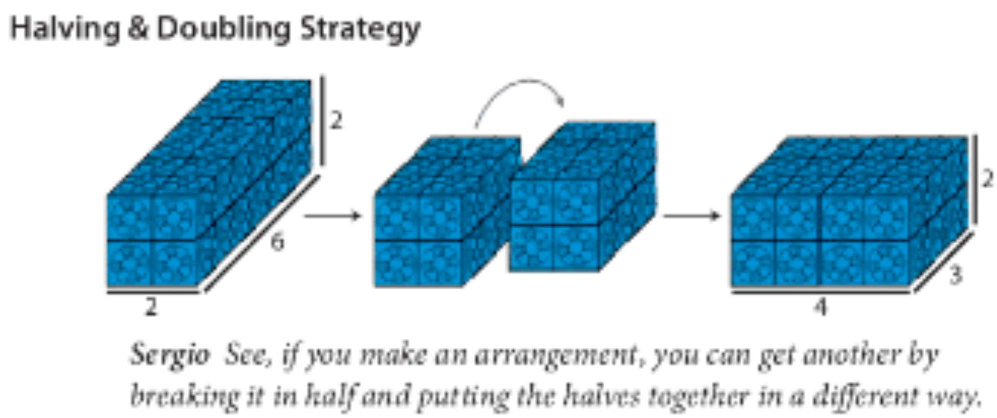
- Understand the concept of volume.

Example:

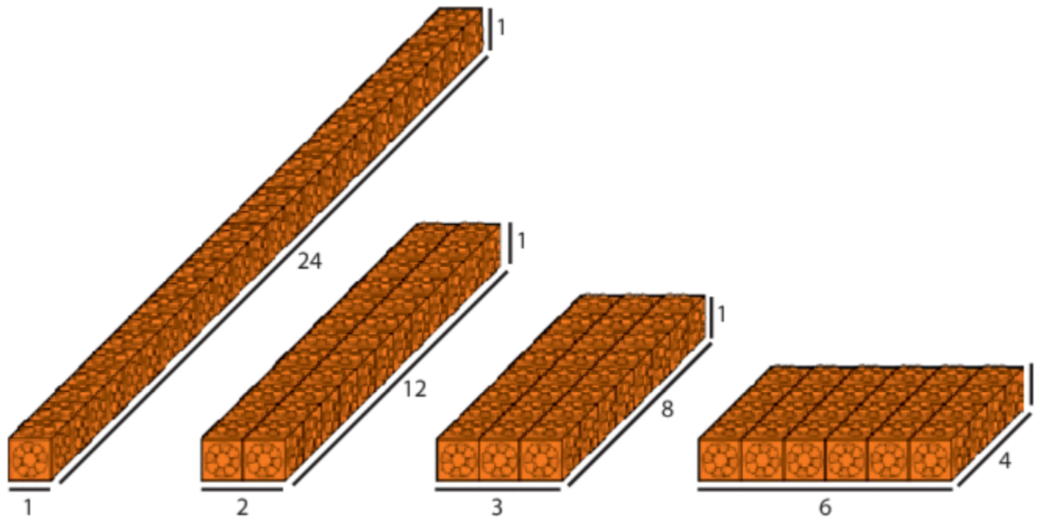
Use varying dimensions of rectangular prisms to model boxes to ship baseball. Example: 12 baseballs in cubes can be arranged in 4 arrangements: 1x12 x1, 6x2x1, 3x4x1, 2x3x2

- Write the expression for volume using the Double Half Strategy and Factors.

Example:



Using the Factors of 24

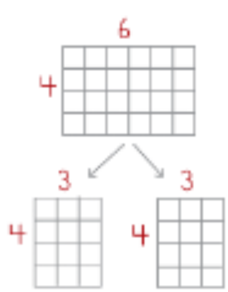


Hannah *I thought about just making an arrangement with 1 layer first. If there's 1 layer, there has to be 24 cubes in that layer, so I thought about the different factor pairs for 24. You have 1 and 24, 2 and 12, 3 and 8, and 4 and 6. These are all really skinny and flat, but now I'm going to see how I can do it in 2 layers and then 3 layers and so on.*

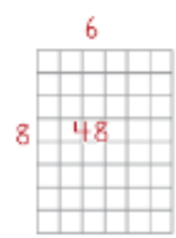
Week Two:

- Create equivalent expressions by doubling a dimension to double the area of a square or rectangle.

Example:



Teacher *What should the 8 × 6 array look like compared to the 4 by 6 and 4 by 3 already up here?*



- Decompose the area of a rectangle into 2 smaller equivalent areas and write the equivalent expressions.

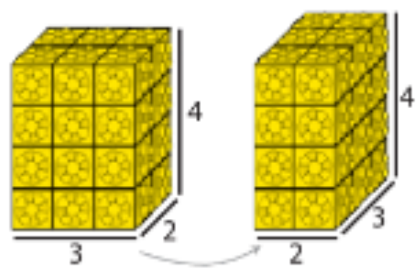
Example:

➢ 8 x 6 = (8 x 3) + (8 x 3)

- Build models using cubes to apply the associative property when finding volume of rectangular prisms.

Example:

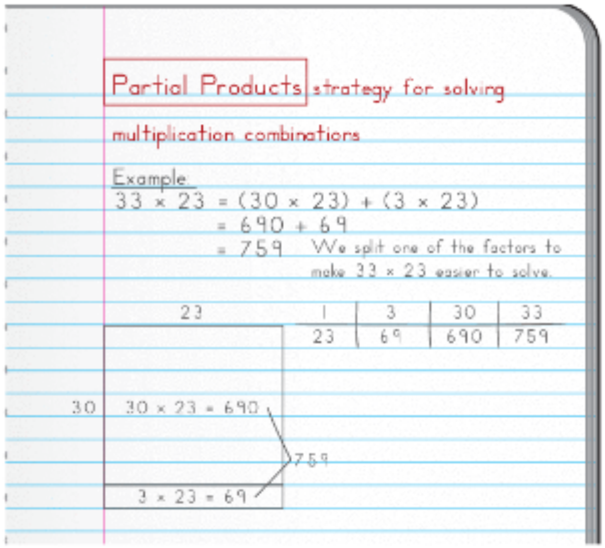
➢ (3 x 2) x 4 (2 x 3) x 4

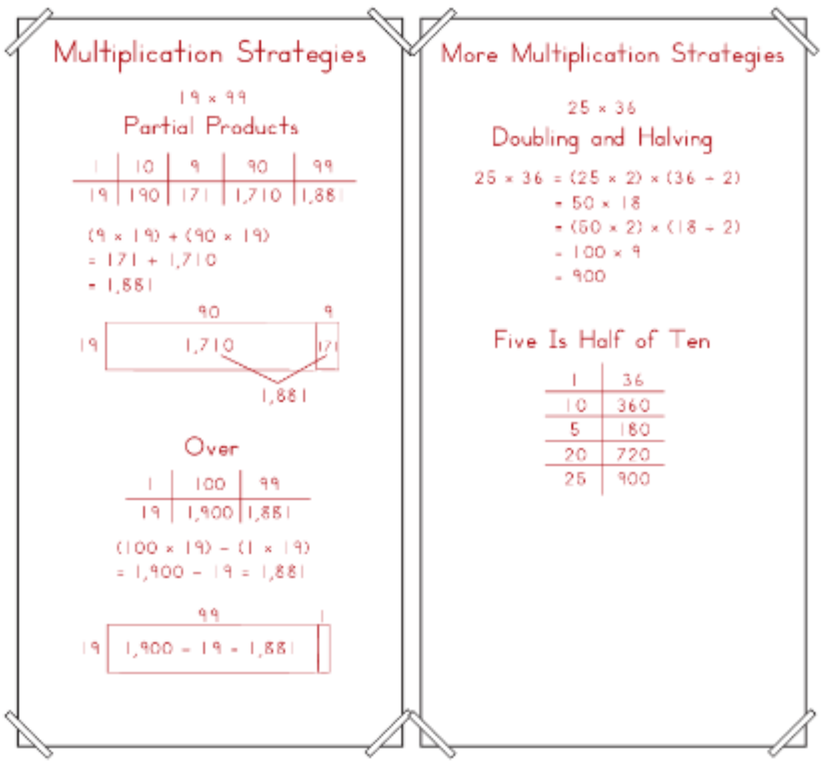


Week Three:

- Apply the multiplication strategies doubling and halving, area models, and partial products to solve problems.

Examples:

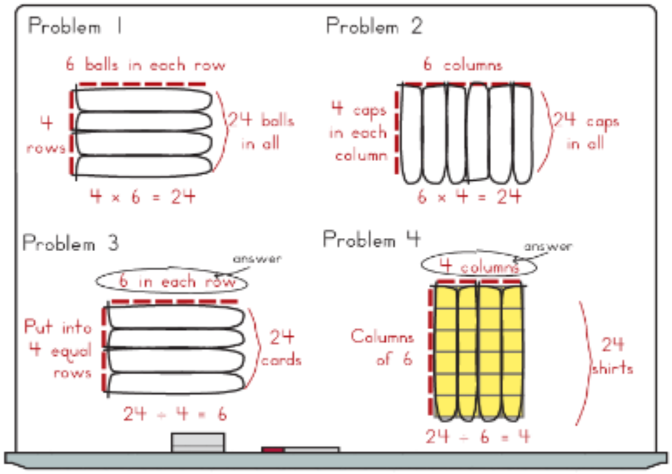




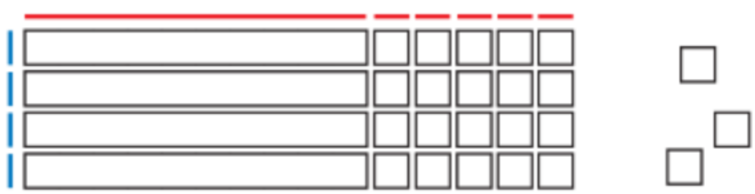
Week Four:

- Model the conceptual understanding of whole number division using the area model and base ten block strategies with and without remainders. Explain the meaning of the remainders in the context of a problem.

Examples:



Brad and Bethany's mom bought pizza to offer to the people who came to the grand opening. She paid exactly $63.00 for 4 giant pizzas. How much did each pizza cost?



After the grand opening, Brad and Bethany's family and friends—all 63 of them—decided to go to the park to play a game of softball. Each car held exactly 4 people, including the driver. How many cars did they need to take everyone to the park?

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…
☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner. Use Unit 1, Module 2, Session 3 activity on surface area.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Checkpoints
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 2: Adding and Subtracting Fractions
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.NF.A.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)*

5.NF.A.2 Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.*
5.NF.B.3 Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$).

Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?* 5.NF.B.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. a. Interpret the product $(a/b) \times q$ as a part of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show $(2/3) \times 4 = 8/3$, and create a story context for this equation. Do the same with $(2/3) \times (4/5) = 8/15$. (In general, $(a/b) \times (c/d) = (ac)/(bd)$.*

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Use mathematical models, clock and money models, and equations to add and subtract fractions and mixed numbers with unlike denominators	*Students will know/understand:* • Adding and subtracting fractions with unlike denominators • Renaming fractions • Common denominators • Equivalent fractions
• Solve problems involving adding three fractions, including mixed number	• Adding fractions with unlike denominators • Renaming fractions • Common denominators • Equivalent fractions
• Understand equivalence to rename fractions	• Renaming fractions • Common denominators • Equivalent fractions • Greatest common factor • Least common multiple
• Compare the value of fractions and mixed numbers	• Equivalent fractions • Greatest common factor

	• Least common multiple
• Identify placement of fractions on a number line	• Renaming fractions • Equivalent fractions • Fraction of a whole number
• Identify decimal equivalents of fractions with tenths and hundredths	• Decimal equivalents of tenths and hundredths
• Find the value of a unit fraction of a whole number (example ⅓ of 27)	• Fraction of a whole number • Fractions on a number line
• Calculate a fraction of a whole number	• Fraction of a whole number
• Use a ratio table to find the best buy	• Equivalent fractions • Ratio tables
• Convert a fraction of an hour to minutes	• Renaming fractions • Equivalent fractions • Ratio tables

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is addition and subtraction of fractions useful?	1. Addition and subtraction of fractions can be applied to real-world problem-solving involving money, recipes, measurement, and time.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Bridges in Mathematics Grade 5 Unit 2 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 5 Mathematics, Number Theory, Fractions, and Mixed Numbers, Add and Subtract Fractions, Multiply Fractions, Decimals, Ratios and Rates
- Math Learning Center apps for Grade 5 Unit 2

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- <u>Fraction</u>: a number expressed as some number of equal parts of a whole
- <u>Denominator</u>: the bottom number in a fraction, which shows into how many equal parts the whole is divided; also, the divisor
- <u>Numerator</u>: the top number in a fraction, which shows how many equal parts are to be counted; also, the dividend
- <u>Equivalent Fractions</u>: two or more different fractions that represent the same quantity.
- <u>Decimal</u>: relating to powers of 10; also, a fraction with a denominator that is a power of 10, often expressed using digits and a decimal point
- <u>Tenth</u>: 1 of 10 equal parts of a whole (1⁄10 or 0.1)
- <u>Hundredth</u>: one of 100 equal parts of a whole (1⁄100 or 0.01)
- <u>Improper Fraction</u>: a fraction greater than 1 that is not expressed as a mixed number; a fraction in which the numerator is larger than the denominator.
- <u>Mixed Number</u>: a number greater than 1 expressed as a whole number plus a fraction whose value is less than 1.

- Unit Fraction: a fraction with a numerator of 1
- Simplest Form: the form of a fraction in which the numerator and denominator have no common factors other than 1.
- Common Denominator: for two or more fractions, a common multiple of the denominators
- Factor: a number that divides evenly into another number
- Multiple: a number that is the product of a given whole number and any other whole number; a number that may be divided by a given number without a remainder; for example, 3, 6, and 12 are multiples of 3
- Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array
- Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs
- Ratio Table: a model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
- Ratio: a comparison of two numbers using division, often expressed as a fraction

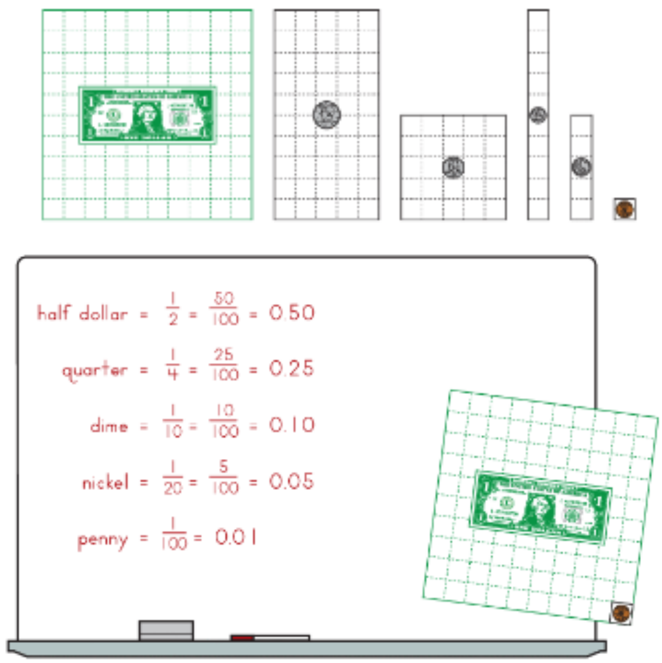
Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students use a variety of strategies to add and subtract fractions with unlike denominators Money and clock models help students develop conceptual understanding to compare, add, and subtract fractions. Students are introduced to ratio tables, greatest common factor, and least common multiple as strategies to find common denominators and learn to simplify fractions. They extend these strategies and models to solve a variety of real-world problems.
Learning Tasks

Week One:

- Use models to add and subtract fractions and mixed numbers with unlike denominators.

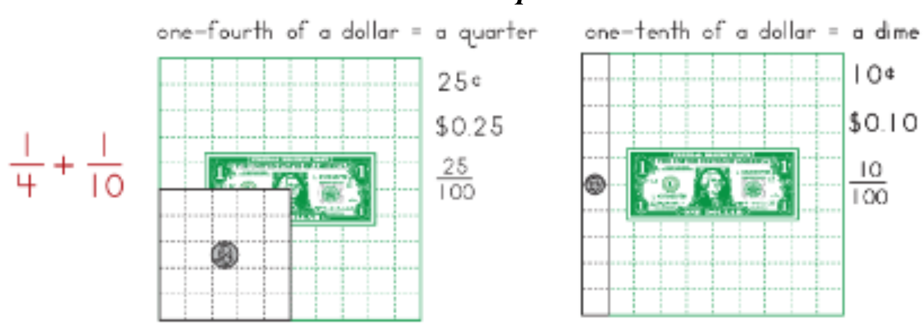
    - ➢ Model fractional parts of a whole using money manipulatives. (Dollar, half dollar, quarter, dime, nickel, penny)

Examples:



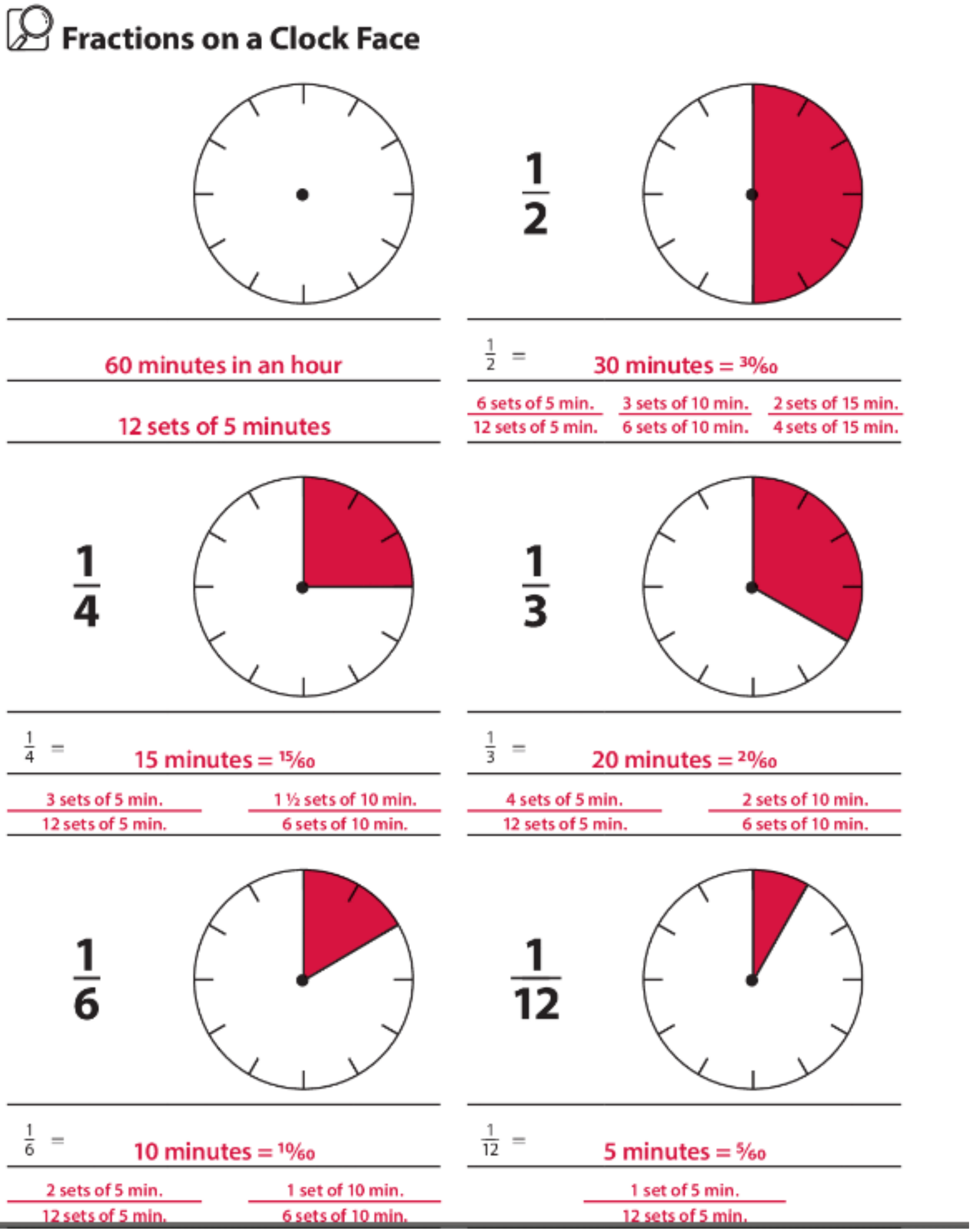
- ➢ Model addition of fractions using money manipulatives and common denominators

Example:



- ➢ Represent minutes as equivalent fractions on a clock face.

Example:



➢ Model fraction addition and subtraction on a clock face

Example:

$\frac{1}{2} + \frac{1}{3}$

$\frac{2}{3} - \frac{5}{12}$ Work will vary. Example below.

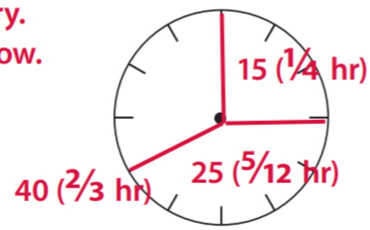
⅔ hour is 40 minutes

5⁄12 hour is 25 minutes

40 – 25 = 15

15 minutes is ¼ hour.

⅔ – 5⁄12 = ¼



➢ Determine the best model to evaluate addition and subtraction expressions.

Examples:

$\frac{1}{2} - \frac{1}{4}$ Work will vary. Example below.

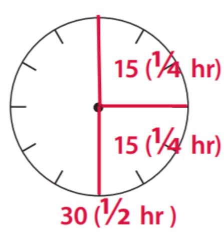
½ hour is 30 minutes

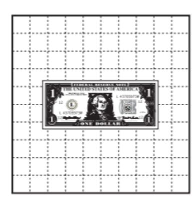
¼ hour is 15 minutes

30 – 15 = 15

15 minutes is ¼ hour.

½ – ¼ = ¼





Which model? Why? Either model will work. Clock model shown.

$\frac{3}{4} - \frac{1}{5}$ Work will vary. Example below.

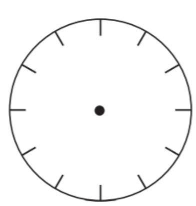
¾ dollar = 75¢

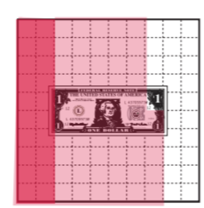
⅕ dollar = 20¢

75 – 20 = 55

55¢ is 55⁄100 or 11⁄20 of a dollar

¾ – ⅕ = 55⁄100 = 11⁄20





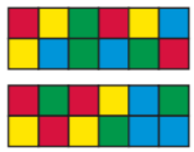
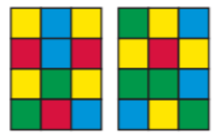
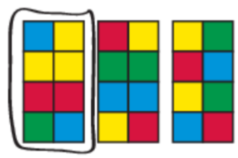
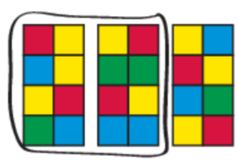
Which model? Why? Money model may work better with fifths. ⅕ = 2⁄10; 2⁄10 of a dollar is 20¢; ¼ = 25¢

Week Two:

- Use models to find equivalent fractions and introduce common denominators.
    - Multiply whole numbers by fractions using an array.

Example:

Using a 4 x 6 array of tiles, show that ½ of 24 is the same as (2 x 6) + (2 x 6) or 2 groups of 12. Explain that ½ of 24 is equivalent to 24 divided by 2.

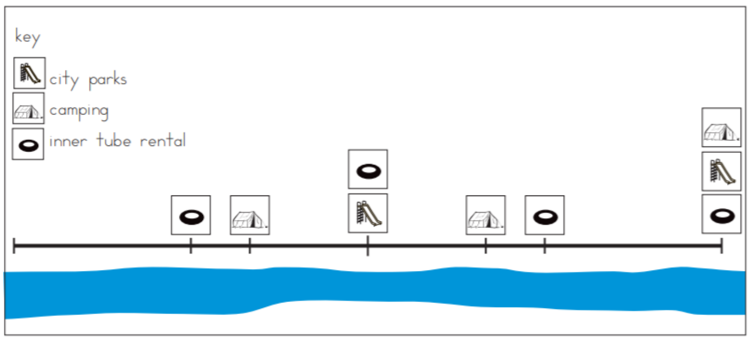
½ of 24 (½ × 24)	The top two rows, the 2 × 6. 	A 4 × 3, which is 12 ½ of 24 is equal to 2 × 6 and 4 × 3. They are all equal to 12. 
⅓ of 24 (⅓ × 24)	Split the 4 × 6 array into 3 groups. One of the groups has 8 tiles in it, so ⅓ of 24 is 8.  ⅓ of 24 ⅓ × 24 = 4 × 2 = 8	
⅔ of 24 (⅔ × 24)	⅔ is ⅓ plus ⅓, so it's 8 tiles plus 8 tiles Split 24 into 3 equal sized groups and find the amount of tiles in 2 of the groups. 	

-
    - Use a number line model to solve real world problems with fractions.

Example:

Becky likes to canoe and hike. There is a new trail that spans 30 kilometers along a nearby river for people to enjoy. Becky wants to canoe down the river along the trail. Becky looked up information about the trail so she would know where she was as sh paddled down the river. She learned that the trail has the following features:

- city parks at the halfway point and at the end of the trail
- campsites every $\frac{1}{3}$ of the trail
- inner tube rental stations every $\frac{1}{4}$ of the trail
- shuttle bus stops every $\frac{1}{5}$ of the trail
- picnic areas every $\frac{1}{6}$ of the trail
- water and bathroom rest areas every $\frac{1}{12}$ of the trail
- kilometer markers every $\frac{1}{15}$ of the trail

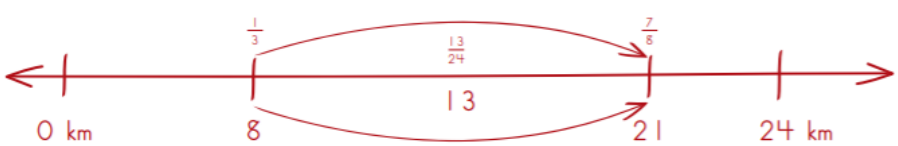


During the first week, Becky canoed down $\frac{5}{12}$ of the section of river before she got out. During the second week, she made it $\frac{9}{15}$ of the trail length. How much farther did she go the second week? Write your answer both in kilometers and as a fraction of the trail. Use the information on your poster to help solve this problem.

- Multiply a fraction by a whole number using a double number line to solve real world problems.

Example:

Mr. Miles walked and ran 7/8 of the trail, and then he walked back 1/3 of the trail. How far from the beginning of the course is he now? What fractional amount of the course is that?



Find the difference between $\frac{1}{3}$ and $\frac{7}{8}$

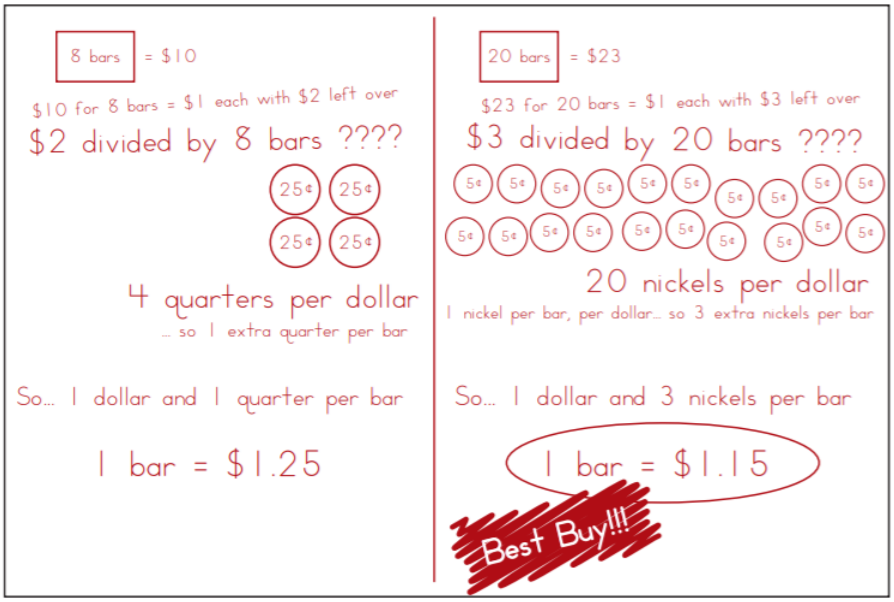
- Determine the better buy using ratio tables and equivalent fractions.

Example:

➢ Which is the best buy?

8 granola bars for $10 or 20 granola bars for $23

20 bars	10 bars	5 bars	1 bar
$23	$11.50	$5.75	



Week Three:

- Use ratio tables to understand equivalent fractions to solve real world problems.

Example:

Granola cost $6 for 5 pounds. What is the cost of 9 pounds of granola?

The correct way to subtract 1 pound:

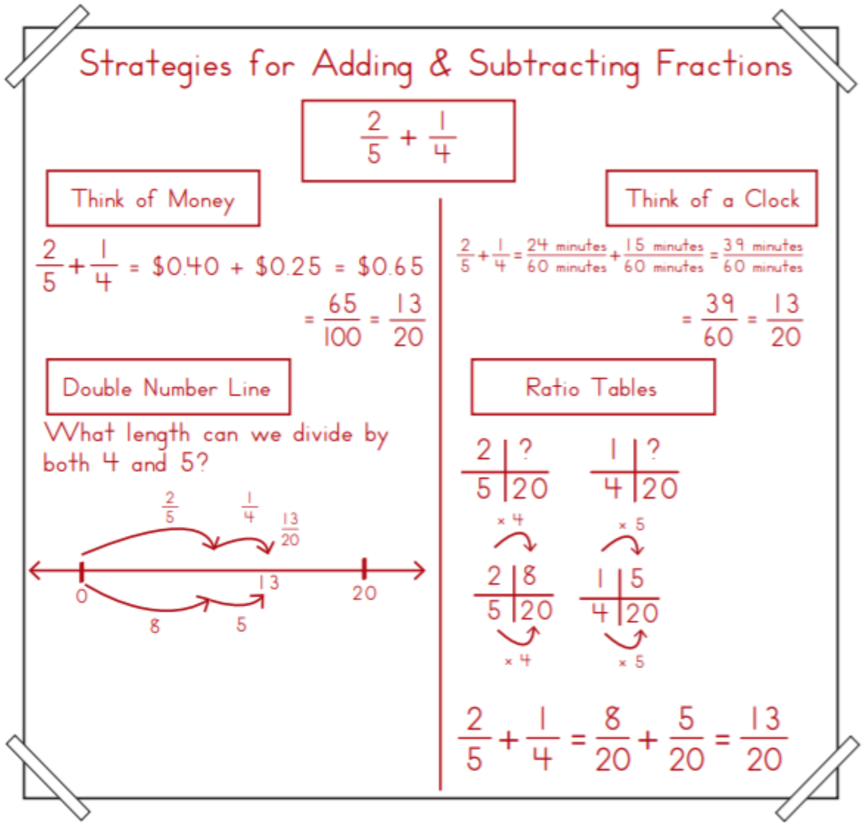
$12 – $1.20

Price	$6	$12	$1.20	$10.80
Pounds	5	10	1	9

10 – 1

If you subtract a pound, you must subtract the price of a pound!

- Use models learned in previous lessons (clocks, money, and ratio tables) to solve addition and subtraction problems with fractions.



Example:

Last night Janae spent ¼ of an hour on her language arts homework and ⅔ of an hour on her math homework. What fraction of an hour did she spend on her homework in all?

Equivalent Fractions for $\frac{2}{3}$

numerator	2	4	8
denominator	3	6	12

Equivalent Fractions for $\frac{1}{4}$

numerator	1	3
denominator	4	12

$$\frac{1}{4} + \frac{2}{3} = \frac{3}{12} + \frac{8}{12} = \frac{11}{12}$$

- Solve story problems involving addition and subtraction of fractions.

Examples:

➢ Zack and Noah jogged ⅖ of a mile and walked another ¼ of a mile. How far did they jog in all?

➢ Mrs. Brown bought a dozen eggs at the store, but when she got home, she discovered that ⅓ of the eggs were broken so she threw them away. She used ⅙ of the dozen in a recipe. How many eggs were left? What fraction of the dozen was left?

- Use the best model/strategy to find common denominators.

How to find common denominators:

- When both denominators are factors of 100, think about money.
- When both denominators are factors of 60, think about a clock.
- You can use a double number line or a ratio table to help rewrite fractions so they have common denominators when clocks or money won't work.
- You can always multiply the denominators to get a common denominator.

Week Four:

- Use the least common multiple to find equivalent fractions and common denominators.

Example:

➢ Carlos had two extra square sandwiches. They were exactly the same size. He gave ¼ of the first sandwich to his friend Ben and ⅓ of the second sandwich to his friend Corey. Ben said, "Hey, that's not fair! Corey got more than I did!" Exactly how much more did Corey get? Divide each sandwich into the same sized pieces to find out.

$\frac{1}{4}$ $\frac{1}{3}$

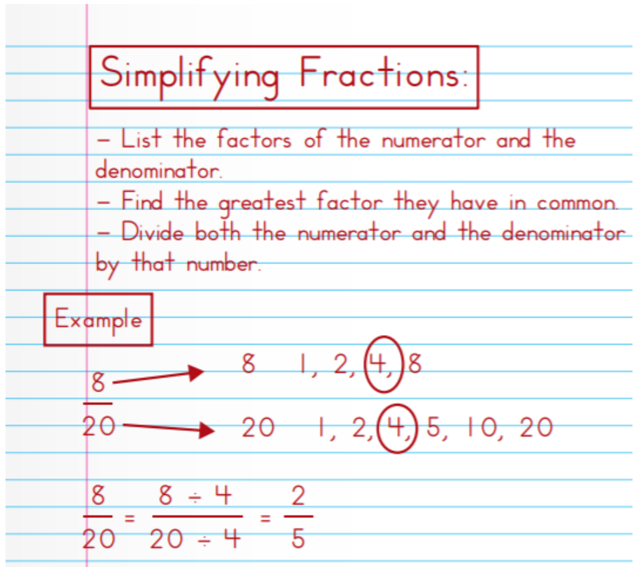
4, 8, 12
3, 6, 9, 12

12 is the least common multiple of 4 and 3.

$$\frac{1 \times 3}{4 \times 3} = \frac{3}{12} \qquad \frac{1 \times 4}{3 \times 4} = \frac{4}{12}$$

Corey got $\boxed{}$ more of a sandwich than Ben.

- Simplify fractions using the greatest common factor.



- Apply least common multiple and greatest common factor strategies to solve real world fraction problems.
    - ➢ Julia bought $\frac{3}{5}$ of a yard of red ribbon and $\frac{10}{15}$ of a yard of purple ribbon.
        a) Which piece was longer?
        b) Exactly what fraction of a yard longer was it?
    - ➢ Anthony goes running 3 times a week. This week, he ran $\frac{3}{5}$ of a mile on Monday, $\frac{2}{3}$ of a mile on Wednesday, and $\frac{3}{4}$ of a mile on Friday. How far did Anthony run this week?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering

☐ Socially Aware ☒ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Checkpoints • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 3: Place Value and Decimals
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.NBT.A.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

5.NBT.A.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10 and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

5.NBT.A.3 Read, write, and compare decimals to thousandths.
   a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$.

b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

5.NBT.A.4 Use place value understanding to round decimals to any place.

5.NBT.B.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Write decimals to the thousandths place using word form, standard form, and expanded form	*Students will know/understand:* • Word form • Standard form • Expanded form
• Compare and order decimals to the thousandths place with and without a number line	• Compare decimal values • Order decimal values
• Identify decimal placement on a number line to thousandths place	• Placement of values on a number line • Compare decimal values • Order decimal values
• Round numbers to the nearest whole, tenth, or hundredth	• Placement of values on a number line • Round numbers
• Solve real world problems involving adding and subtracting decimals to the hundredths place	• Adding and subtracting decimals
• Solve real world problems involving multiplying a decimal by 1, 10, 100, 1000, 10000 using concepts of place value	• Multiplying with whole number powers of ten
• Convert measurement units within the metric system	• Metric system • Conversions within the metric system

• Understand how the metric system relates to the base 10 number system	• Metric system • Conversions within the metric system • Powers of ten

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are understanding decimals and decimal place values useful?	1. Understanding decimals and decimal place value can be applied to real-world problem solving like money and measurement.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Bridges in Mathematics Grade 5 Unit 3 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 5 Mathematics, Place Value and Number Sense, Decimals, Add and Subtract Decimals, Units of Measure, Money

- Math Learning Center apps for Grade 5 Unit 3

Vocabulary/Terminology

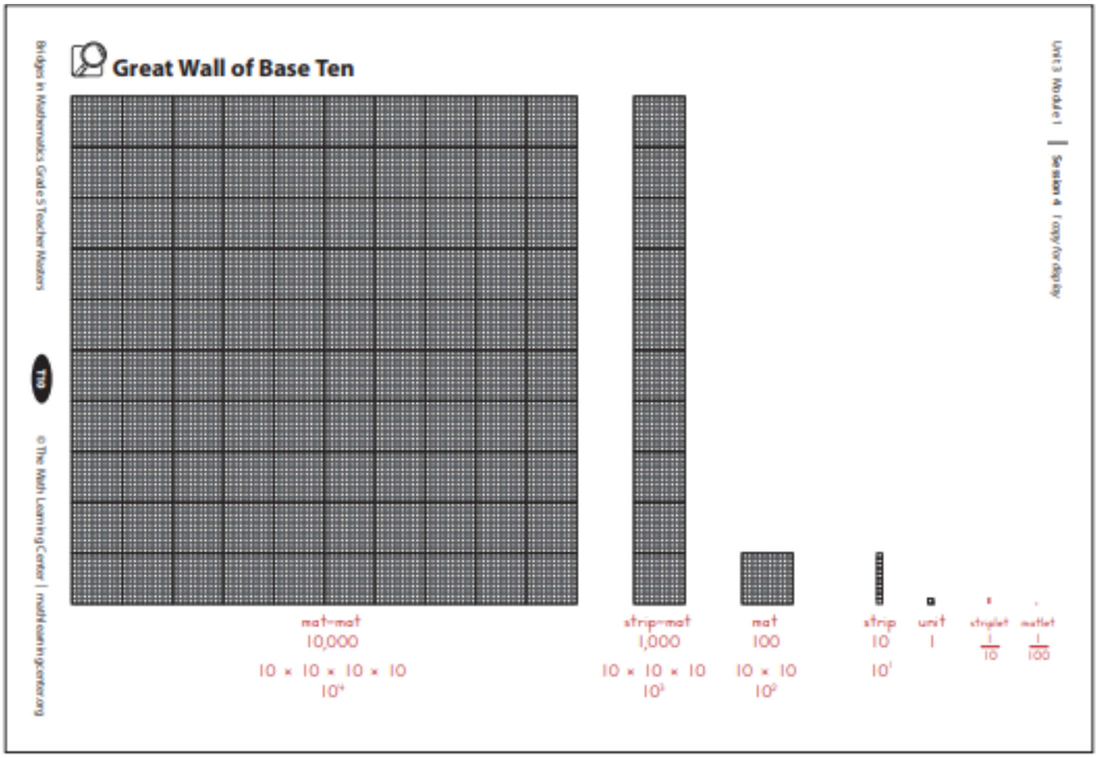
Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- Decimal: relating to powers of 10; also, a fraction with a denominator that is a power of 10, often expressed using digits and a decimal point
- Tenth: 1 of 10 equal parts of a whole (1⁄10 or 0.1)
- Hundredth: one of 100 equal parts of a whole (1⁄100 or 0.01)
- Thousandth: 1 of 1,000 equal parts of a whole (1⁄1000 or 0.001)
- Standard Form: (base ten numeral) a number written such that the position of each digit corresponds to a power of ten (tens, hundreds, thousands, tenths, hundredths, thousandths, etc.)
- Expanded Form: a way to write a number that shows the place value of each digit.
- Rounding: approximating a number to a specific place value based on the digit immediately to the right of that place; for example, rounding $3.82 to the nearest dollar is $4 or rounding 63 to the nearest ten is 60
- Exponent: a number or symbol that indicates the power to which the base number is raised; for example, in this expression, the exponent 2 indicates that 3 is raised to the second power: $3^2 = 3 \times 3$
- Metric System: a system of measurement based in tens.
- Difference: the result of subtracting one number from another; the amount by which one number is greater or less than another number
- Multiply: to find the product of
- Dimension: the length, width, or height of a figure
- Sum: the result of adding two or more numbers
- Divide: to break or split into equal parts; to determine how many times one number goes into another
- Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation

- Fraction: a number expressed as some number of equal parts of a whole
- Meter: a metric unit of length equal to 100 centimeters
- Centimeter: a metric unit of length equal to 1⁄100 of a meter
- Millimeter: a metric unit of length equal to one-thousandth of a meter
- Kilometer: a metric unit of length equal to 1,000 meters
- Liter: a metric unit of capacity equal to 1,000 milliliters
- Milliliter: a metric unit of capacity equal to one-thousandth of a liter
- Gram: a metric unit of mass equal to one thousandth of a kilogram or about the weight of a standard paperclip
- Kilogram: a metric unit of mass equal to 1,000 grams
- Milligram: a metric unit of mass equal to one-thousandth of a gram

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students read, write, compare, and round decimals. Students examine the decimal patterns when multiplying and dividing numbers by a power of 10. Students convert within a measurement system using their place value understanding. Students apply whole numbers of strategies and place value understanding to add and subtract decimals to the hundredths.
Learning Tasks
Week One: • Extend student understanding of the base ten place value system to the thousandths place using manipulatives and a place value chart. ***Example:***

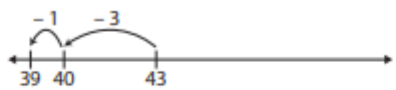
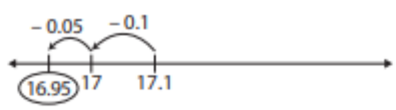


Because these pieces are almost too small to work with, the teacher proposes a shift in which the mat becomes the new unit and is assigned a value of 1, while the values of the other pieces are rescaled proportionally.

- Add and subtract whole numbers and decimals using number lines and the compensation strategy.

Example:

Problem String Decimal Subtraction, Part 1

Problems	Sample Strategies & Recording	Connections
43 – 4	Call on a student who used removal to solve this problem. 	**Big Idea** In general, removal is a more efficient strategy when the numbers are far away from each other, and finding the distance is more efficient when numbers are close together. Some students may always choose to remove when given a subtraction problem. Validate both strategies, but have students who alternate verbalize how and why they choose one strategy over the other.
52 – 49	Call on a student who used differencing to solve this problem. 	
19.2 – 18.9	Call on a student who used differencing to solve this problem. 	To help students transition from whole numbers to decimals, read each of these problems to the class in terms of money and then in terms of decimals after you write it on the board (e.g., nineteen dollars and twenty cents minus eighteen dollars and ninety cents; nineteen and two tenths minus eighteen and nine tenths).
17.1 – 0.15	Call on a student who used removal to solve this problem. 	

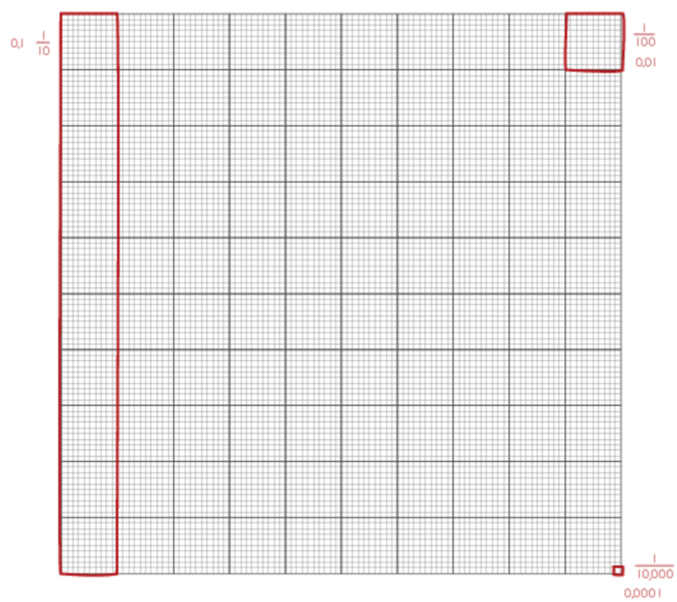
Ask if there are any students who removed for 19.2 – 18.9 or added up (found the distance) for 17.1 – 0.15. Encourage students to think about when they might prefer one strategy over the other.

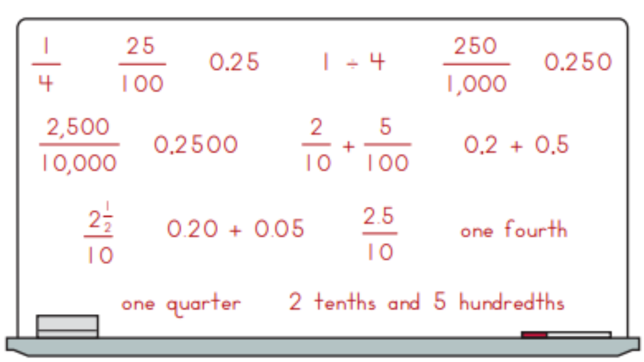
- Solve real world problems with money to understand place value patterns when multiplying and dividing by whole number powers of ten.

Examples:

- ➢ Ten friends are planning an outing to an art museum. If each of the 10 friends pays $8.00 in admission, how much will they pay in all?
- ➢ If ten friends each pay a bus driver $0.80 for bus fare, how much will they pay in all?
- ➢ The ten friends heard they will get a refund of $5.40 if they pay in advance. How much will each friend get if they split the $5.40 evenly?
- ➢ The 10 friends learned that the refund will only be $0.60. How much will each friend get if they split the $0.60 evenly?

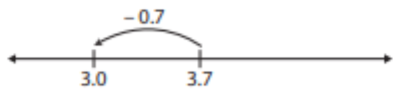
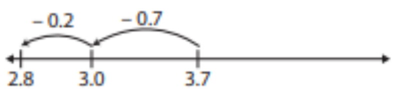
● Model decimals using manipulatives such as base ten blocks. Students understand that 10 tenths is equivalent to one whole and 10 hundredths is equal to one tenth. ***Examples:*** ➢ 15 tenths is equal to one whole unit and five tenths ➢ 105 hundredths is one whole unit and five hundredths ➢ 10 units, 9 tenths, and 11 hundredths is equal to 1 ten, 1 unit, and 1 hundredth.
Week Two: ● Use models to extend understanding of decimal place value to include thousandths and ten thousandths. ***Examples:***





- Model how to subtract decimals using a number line.

Problem String Decimal Subtraction

Problems	Sample Strategies & Recording	Connections
3.7 – 0.7		**Big Idea** These two problems are paired in such a way as to encourage students to jump to the nearest friendly number (3.0 in this case), and then remove the rest. Many students will likely use a removal strategy to subtract 7⁄10 (or 70 cents, in money terms) from 3 7⁄10 (3 dollars and 70 cents). When you call on students to share their strategies for the second combination, see if you can find a student who used the results of the first problem to inform her work on the second.
3.7 – 0.9		
4.2 – 0.2		In discussing 4.2 –0.3, emphasize the use of getting to a friendly number, 4.0, first, and then jumping back another tenth. Press students to explain what they are taking away in both problems—tenths, or dimes.
4.2 – 0.3	Again, find a student who used the first of the two, the helper problem, to solve the second one. 	

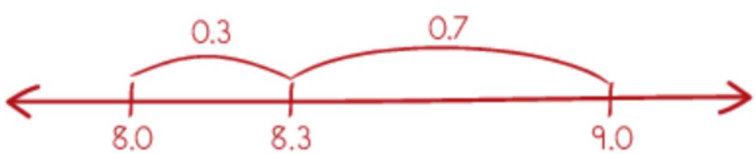
Problem string continued on next page

Problems	Sample Strategies & Recording	Connections
7.46 – 0.46	After you record each of the next two problems on the board, have students read it with you as a decimal combination, and then as a money combination. – 0.46 7.00 7.46	Thinking about the first problem in terms of money—7 dollars and 46 cents minus 46 cents—and then using the result to solve the second problem, again in terms of money, will scaffold students' work. For some it may be easier to understand that they are removing 6 more hundredths in the second problem if they can think of the hundredths as pennies.
7.46 – 0.52	Again look for students who are able to use the results of the first problem to help solve the second. – 0.06 – 0.46 6.94 7.00 7.46	
1.82 – 0.83	For this problem and the next, find students who use the "get to a friendly number strategy" even though a helper problem is not offered. – 0.01 – 0.82 0.99 1.00 1.82	As students explain their thinking and you model it on the board, continue to work with the class to be very clear about what they're removing. In the first problem, it's 83 hundredths, or 83 cents. In the second, it's 48 hundredths, or 48 cents.
28.32 – 0.48	– 0.06 – 0.10 – 0.32 27.84 27.90 28.00 28.32	

- Round decimals to the nearest whole number using a number line.

Example:

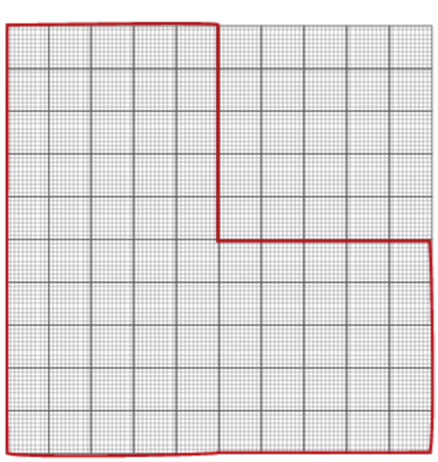
  - ➢ Round 8.3 to the nearest whole number



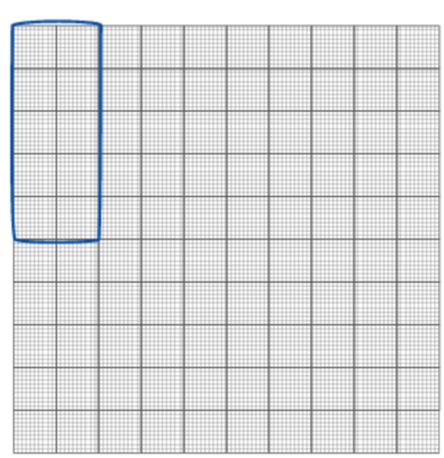
- Use various strategies and models to understand equivalent decimals and fractions.

Examples:

		$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{3}{4}$	$\frac{1}{8}$	$\frac{1}{3}$
Tenths	Fraction		$\frac{5}{10}$							
	Decimal		0.5							
Hundredths	Fraction	$\frac{25}{100}$	$\frac{50}{100}$							
	Decimal	0.25	0.50							
Thousandths	Fraction	$\frac{250}{1,000}$	$\frac{500}{1,000}$							
	Decimal	0.250	0.500							



¾ (0.75)

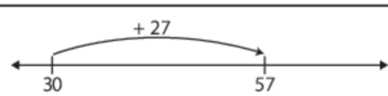
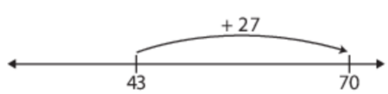


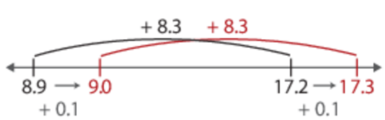
⅛ (0.125)

Fraction of a Dollar	Coin Name	Dollars & Cents Notation	Decimal
$\frac{1}{2}$	half dollar	$0.50	0.50
$\frac{1}{4}$			
$\frac{1}{10}$			
$\frac{1}{5}$			
$\frac{1}{20}$			
$\frac{1}{100}$			

Week Three:

- Understand decimal subtraction problems using the Constant Differences strategy.

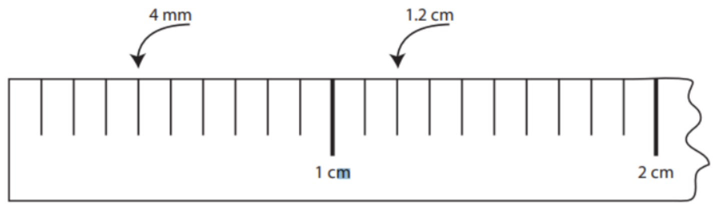
Problems	Sample Strategies & Recording	Connections
57 – 30		**Big Idea** Students will likely agree that 57 – 30 is the easiest in the set because it's so easy to solve mentally. The larger point to make with the class is that in using the constant difference strategy, it's optimal to change the second number—the subtrahend—to a multiple of 1, 10, 100, 1,000, etc.
70 – 43		

Problems	Sample Strategies & Recording	Connections
17.2 – 8.9	 17.2 + 0.1 = 17.3 – 8.9 + 0.1 = 9.0 8.3	Some students may suggest subtracting two-tenths from both numbers to produce 17.0 – 8.7. If this happens, press to see if they can find a way to shift both numbers in such a way that the subtrahend becomes friendly. If necessary, guide students to shifting both numbers up by one-tenth to produce the combination 17.3 – 9.0, which can be solved mentally. Students might also suggest adding 1.1 to both the minuend and the subtrahend to produce 18.3 – 10.0, also very easy to solve.

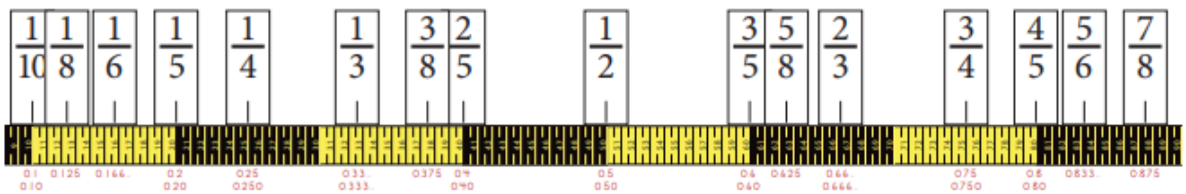
- Solve addition and subtraction problems with decimals.

- Use models to understand decimal placement on a number line.

Examples:



The marks are 1 millimeter, or $\frac{1}{1000}$ of a meter, apart.



Use a base ten linear piece to locate and mark these decimals on the number line. Write the numbers above the line.

0.1 0.4 0.8 1.2 1.5 1.8

Week Four:

- Convert the metric equivalents using understanding of multiplying by tens and using ratio tables.

÷ 2

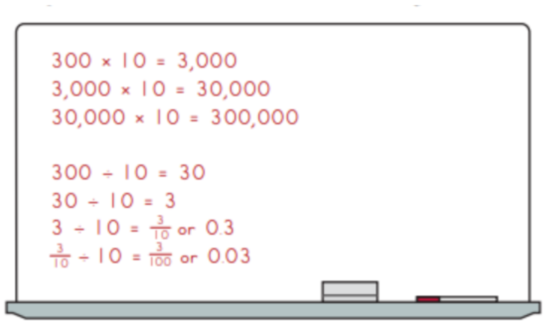
cm	1	10	20	5	25
mm	10	100	200	50	250

÷ 2

kg	1	2	0.3	2.3
g	1,000	2,000	300	2,300

- Solve real world problems involving conversions in the metric system.

- Understand place value patterns multiplying and dividing decimals by powers of ten.



- Using understanding of place value, solve problems with addition and subtraction with decimals vertically.

Examples:

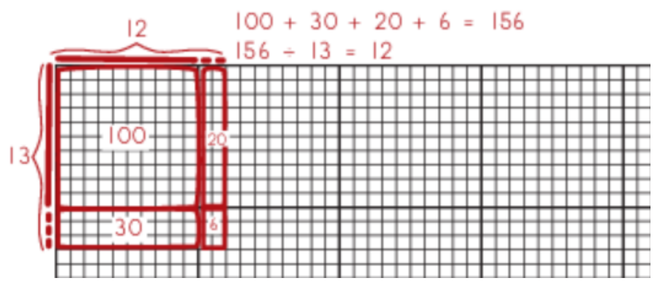
$$\begin{array}{r} 75.6 \\ +\ 29.9 \\ \hline \end{array} \qquad \begin{array}{r} 4.76 \\ +\ 4.38 \\ \hline \end{array}$$

Week Four:

- Write and model division story problems using base ten blocks.

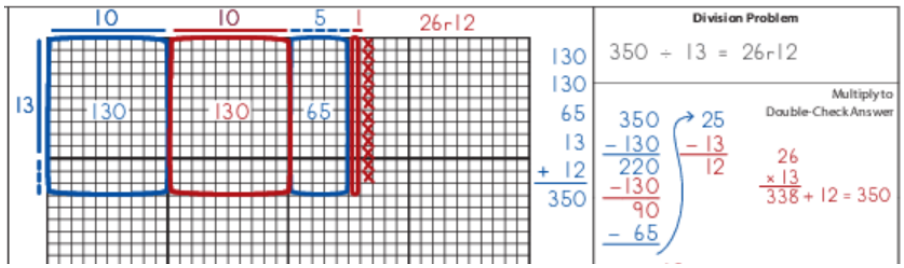
Example:

We picked 156 apples yesterday.
We put the same number of the apples into 13 bags.
How many apples were in each bag?



- Solve division problems using base ten blocks with and without remainders.

Example:



Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Checkpoints • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 4: Multiplying and Dividing Whole Numbers and Decimals
Pacing	Five weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.OA.A.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

5.OA.A.2 Write simple expressions that record calculations with numbers and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.*

5.NBT.B.5 Fluently multiply multi-digit whole numbers using the standard algorithm.

5.NBT.B.6 Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the

relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 5.NBT.B.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. 5.NF.B.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. a. Interpret the product $(a/b) \times q$ as a part of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = (ac)/(bd).* 5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Solve multiplication and division problems using mental math strategies	*Students will know/understand:* • Mental math strategies for multiplication and division • Partial products • Partial quotients
• Solve multi-digit multiplication problems using partial products, area model, and the standard algorithm with and without context	• Partial products • Partial quotients • Area model • Standard algorithm for multiplication of multi-digit numbers
• Divide using partial quotients	• Partial quotients
• Use ratio tables to solve multiplication and division problems	• Ratio tables • Partial products

	• Partial quotients
• Calculate a fraction of a whole	• Fraction of a whole

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are multiplying and dividing multi-digit whole numbers and decimals useful?	1. Multiplying and dividing multi-digit whole numbers and decimals can be applied to real-world problem solving like money, measurement, scientific problem solving, and data and statistics.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Bridges in Mathematics Grade 5 Unit 4 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 5 Mathematics, Multiplication, Division, Multiply Decimals, Divide Decimals, Multiply Fractions.
- Math Learning Center apps for Grade 5 Unit 4

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- Multiply: to find the product of
- Dimension: the length, width, or height of a figure
- Sum: the result of adding two or more numbers
- Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation
- Algorithm: a step-by-step procedure for computing that gives the correct result in every case when the steps are carried out correctly
- Factor: a number that divides evenly into another number
- Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array
- Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs
- Area: the total number of square units needed to cover a two-dimensional surface
- Array: an arrangement consisting of equal rows and equal columns
- Ratio Table: a model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions.
- Divide: to break or split into equal parts; to determine how many times one number goes into another
- Dividend: the number that will be divided in a division problem
- Divisor: the number in a division problem that divides the dividend
- Quotient: the result or answer in division; the number of times one quantity goes into another
- Equation: a mathematical statement asserting that two quantities have the same value
- Area model of multiplication: a model in which two numbers being multiplied are

represented by the dimensions of a rectangle, and their product is represented by the area of the rectangle

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students improve their number sense through practice with estimation and mental math skills. Students learn the standard algorithm for multiplication and review partial products and the area model. Students continue learning strategies for solving division problems, such as the area model and ratio tables, to strengthen their understanding of the connection between multiplication and division. Students learn the connections for each strategy between whole numbers, decimals, and fractions.
Learning Tasks

Week One:

- Model multiplication using a ratio table.

Big Idea

In a ratio table, the relationship between the numbers on both sides of the table has to stay the same. When you multiply one side by 10, you have to do the same to the other side. However, the numbers on the right side of these tables are all 35 times their corresponding numbers on the left side because each box contains 35 pencils.

So when you take away 1 box from the left side, you have to take away 35 pencils from the other side of the table. When you add 4 boxes of pencils to the left side, you have to add 4 × 35, or 140 pencils to the right side.

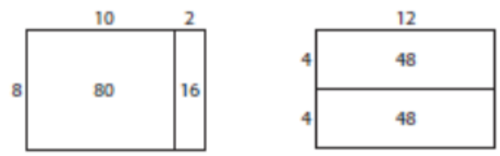
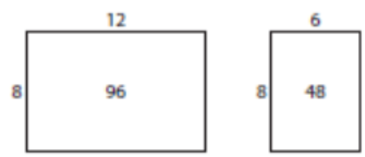
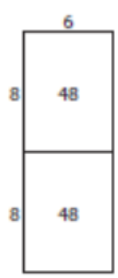
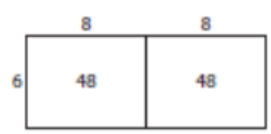
<table>
<tr><th>Problems</th><th>Sample Strategies & Recording</th></tr>
<tr><td rowspan="2">My favorite pencils come in boxes of 35, so I know that if I have one box, I have 35 pencils. How many pencils would there be in 4 boxes?
4 × 35</td>
<td>Some students may solve the problem by skip-counting or using repeated addition. This can be modeled on a ratio table as shown here.
<table>
<tr><th></th><th>Number of Boxes</th><th>Number of Pencils</th><th></th><th></th></tr>
<tr><td></td><td>1</td><td>35</td><td></td><td>1 × 35 = 35</td></tr>
<tr><td>+ 1</td><td></td><td></td><td>+ 35</td><td></td></tr>
<tr><td></td><td>2</td><td>70</td><td></td><td>2 × 35 = 70</td></tr>
<tr><td>+ 1</td><td></td><td></td><td>+ 35</td><td></td></tr>
<tr><td></td><td>3</td><td>105</td><td></td><td>3 × 35 = 105</td></tr>
<tr><td>+ 1</td><td></td><td></td><td>+ 35</td><td></td></tr>
<tr><td></td><td>4</td><td>140</td><td></td><td>4 × 35 = 140</td></tr>
</table></td></tr>
<tr><td>Other students may have used a Double-Doubles strategy, first doubling 35 to get 70, and then doubling 70 to determine that 4 × 35 = 140.
<table>
<tr><th></th><th>Number of Boxes</th><th>Number of Pencils</th><th></th><th></th></tr>
<tr><td></td><td>1</td><td>35</td><td></td><td>1 × 35 = 35</td></tr>
<tr><td>× 2</td><td></td><td></td><td>× 2</td><td></td></tr>
<tr><td></td><td>2</td><td>70</td><td></td><td>2 × 35 = 70</td></tr>
<tr><td>× 2</td><td></td><td></td><td>× 2</td><td></td></tr>
<tr><td></td><td>4</td><td>140</td><td></td><td>4 × 35 = 140</td></tr>
</table></td></tr>
<tr><td rowspan="2">How many pencils in 40 boxes?
40 × 35</td>
<td>Some students may first multiply the number of boxes and pencils by 10, and then replicate the Double-Doubles strategy used in the previous problem.
<table>
<tr><th></th><th>Number of Boxes</th><th>Number of Pencils</th><th></th><th></th></tr>
<tr><td></td><td>1</td><td>35</td><td></td><td>1 × 35 = 35</td></tr>
<tr><td>× 10</td><td></td><td></td><td>× 10</td><td></td></tr>
<tr><td></td><td>10</td><td>350</td><td></td><td>10 × 35 = 350</td></tr>
<tr><td>× 2</td><td></td><td></td><td>× 2</td><td></td></tr>
<tr><td></td><td>20</td><td>700</td><td></td><td>20 × 35 = 700</td></tr>
<tr><td>× 2</td><td></td><td></td><td>× 2</td><td></td></tr>
<tr><td></td><td>40</td><td>1,400</td><td></td><td>40 × 35 = 1,400</td></tr>
</table></td></tr>
<tr><td>Others may simply multiply the answer to the first problem by 10, reasoning that 40 is ten times as much as 4.
<table>
<tr><th></th><th>Number of Boxes</th><th>Number of Pencils</th><th></th><th></th></tr>
<tr><td></td><td>1</td><td>35</td><td></td><td>1 × 35 = 35</td></tr>
<tr><td></td><td>4</td><td>140</td><td></td><td>4 × 35 = 140</td></tr>
<tr><td>× 10</td><td></td><td></td><td>× 10</td><td></td></tr>
<tr><td></td><td>40</td><td>1,400</td><td></td><td>40 × 35 = 1,400</td></tr>
</table></td></tr>
</table>

How many pencils in 39 boxes? 39 × 35	Look for a student who made use of the answer to the previous problem to solve this one. Number of Boxes | Number of Pencils 1 | 35 — 1 × 35 = 35 4 | 140 — 4 × 35 = 140 × 10: 40 | 1,400 (× 10) — 40 × 35 = 1,400 − 1: 39 | 1,365 (− 35) — 39 × 35 = 1,365
How many pencils in 44 boxes? 44 × 35	Look for a student who used previous problems to solve this one. Number of Boxes | Number of Pencils 1 | 35 — 1 × 35 = 35 4 | 140 — 4 × 35 = 140 × 10: 40 | 1,400 (× 10) — 40 × 35 = 1,400 + 4: 44 | 1,540 (+ 140) — 44 × 35 = 1,540

- Model Half-Tens strategy of multiplication

Problems	Sample Strategies & Recording
10 × 18	Regardless of the fact that most students just know the answer, use a ratio table to represent the situation in order to set the stage for the next combination in the string. × 10 1 | 10 18 | 180 × 10
5 × 18	Look first for a student to share who used the partial products 5 × 10 and 5 × 8, and then look for someone who used 10 × 18, dividing 180 by 2 to get the answer, or suggest it yourself. Show each strategy on a ratio table, and then ask students to compare the two. 10 + 8 1 | 10 | 8 | 18 5 | 50 | 40 | 90 50 + 40 5 × 18 = (5 × 10) + (5 × 8) = 50 + 40 = 90 × 10 ÷ 2 1 | 10 | 5 18 | 180 | 90 × 10 ÷ 2 18 × 10 = 180 180 ÷ 2 = 90
15 × 18	Look for a student who combined the results of the first two problems to get the answer. 10 + 5 1 | 10 | 5 | 15 18 | 180 | 90 | 270 180 + 90

- Model Doubling and Halving strategies of multiplication using area models

Problems	Sample Strategies & Recording	Connections
4 × 12	While some students will likely know the answer from memory, others may use a partial product strategy, multiplying 4 × 10, then 4 × 2, and adding the two products. Model both approaches on open arrays.  4 × 12 = 48 4 × 12 = 4 x (10 + 2) = (4 × 10) + (4 × 2) = 40 + 8 = 48	**Big Idea** When one of the factors in a multiplication combination is doubled, the product doubles. When one of the factors is halved, the product is halved as well.
8 × 12	Look for a student who used partial products—(8 × 10) + (8 × 2)—to solve the problem, and another who made use of the previous problem, noting that since 8 is twice as much as 4, the product of 4 × 12 can be doubled to get 8 × 12. Model both strategies on open arrays.  8 × 12 = 8 x (10 + 2) = (8 × 10) + (8 × 2) = 80 + 16 = 96 48 + 48 = 96	
8 × 6	Look for a student who made a connection between this combination and the previous one, reasoning that because 6 is half of 12, the product of 8 × 6 will be half of 8 × 12. Reinforce this by sketching two open arrays, one for 8 × 12, and one for 8 × 6, and asking students to compare the two. Note with them that the second array is half the first, and press them to explain why. 	
6 × 16	Ask students to predict the product before they work the combination. Look for a student who doubled 8 × 6 to get the answer.   48 + 48 = 96 48 × 2 = 96	

$4 \times 12 = 48$
$8 \times 12 = 96$
$8 \times 6 = 48$
$16 \times 6 = 96$

× 2 ÷ 2 × 2 (left); × 2 ÷ 2 × 2 (right)

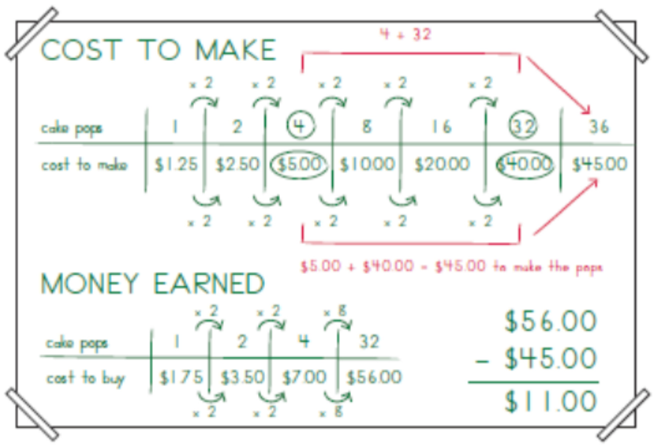
- Apply and model strategies of multiplication with decimals using money

Examples:

- ➢ Callie is trying to earn money to purchase a new pair of soccer cleats. She has decided to make her famous cake pops and sell them to her friends. Callie's mom is willing to loan her the money to get the fundraiser started. Callie knows that her cake pops cost $1.25 to make, and she'd like to make 36 of them. How much money does Callie need to borrow from her mom?

- ➢ Callie priced her cake pops at $1.75 each and sold 32 of them. How much money did Callie collect for her 32 cake pops?

- ➢ How much did Callie earn to put toward her soccer cleats? (What was her profit?)



Week Two:

- Connect multiplication of fractions, decimals, and whole numbers

Problems	Sample Strategies & Recording	Connections
25×32	Model student responses as arrays and ratio tables.	See dialog above.
¼ of 32	Some students will likely divide 32 by 2 and then by 2 again, while others may simply divide 32 by 4. $\begin{array}{c\|c} 1 & 32 \\ \frac{1}{2} & 16 \\ \frac{1}{4} & 8 \end{array}$ ÷ 2, ÷ 2 $1 \times 32 = 32$ $\frac{1}{2} \times 32 = 16$ $\frac{1}{4} \times 32 = 8$ $32 \div 2 = 16$ and $16 \div 2 = 8$ *or* $32 \div 4 = 8$	**Big Idea** Since 0.25 is the same as ¼, 0.25×32 is equivalent to finding one-fourth of 32, or dividing it by 4.
0.25×32	Look for a student who thought about the problem in terms of quarters, and another who applied the fact that 0.25 = ¼. Two possible approaches: 0.25 is a quarter of a dollar: $\begin{array}{c\|c} 4 & \$1 \\ 8 & \$2 \\ 16 & \$4 \\ 32 & \$8 \end{array}$ × 2, × 2, × 2 $4 \times 0.25 = \$1.00$ $8 \times 0.25 = \$2.00$ $16 \times 0.25 = \$4.00$ $32 \times 0.25 = \$8.00$ 0.25 = ¼ ¼ of 32 = 8, so $0.25 \times 32 = 8$	

- Model multiplication connections with non-unit fraction

<table>
<tr><th>Problems</th><th>Sample Strategies & Recording</th><th>Connections</th></tr>
<tr><td>¼ × 8</td><td>Most students will likely know the answer without having to do any computation in their journals, especially if they understand that ¼ × 8 is the same as one-fourth of 8, or 8 ÷ 4.</td><td>When you write the first combination on the board, review with students that ¼ × 8 means one-fourth of 8.</td></tr>
<tr><td>¾ of 8</td><td>Here, some students are likely to reason that if ¼ of 8 is 2, then ¾ of 8 is 6. You can reinforce this by recording a ratio table on the board similar to the one shown here.
$$\begin{array}{r|l} 1 & 8 \\ \hline \frac{1}{4} & 2 \\ \hline \frac{3}{4} & 6 \end{array} \qquad \times\tfrac{1}{4},\ \times 3$$
$1 \times 8 = 8$
$\frac{1}{4} \times 8 = 2$
$\frac{3}{4} \times 8 = 6$</td><td rowspan="2">Big Idea
Finding ¾ of a number is the same as finding ¼ of that number and multiplying the results by 3 because ¾ = 3 × ¼.
Since 0.75 is the same as ¾, multiplying a number by 0.75 is equivalent to finding ¼ of the number and multiplying the result. Another way to find the answer to 0.75 × n is to divide n by 4, and multiply the result by 3.</td></tr>
<tr><td>0.75 × 8</td><td>Since 0.75 = ¾, the answer to this problem is the same as the one above: 6.</td></tr>
<tr><td rowspan="3">75 × 9</td><td>Look for a student who was able to use the results of the previous problem to help solve this one. This would be a student who reasons that if 0.75 × 8 is 6, then 75 × 8 must be 600 because 75 is 100 times as much as 0.75. By adding one more set of 75 to 600, you have the answer to 75 × 9.
$0.75 \times 8 = 6 \xrightarrow{\times 100} 75 \times 8 = 600$
$75 \times 1 = 75$
$75 \times 9 = 675$</td><td rowspan="3">Big Idea
One strategy for multiplying by 75 is to find ¾ of at least part of the number, scale up, and work from there.</td></tr>
<tr><td>Then compare the strategy with others the students are likely to share, such as using partial products.
$75 \times 9 = (70 + 5) \times 9 = (70 \times 9) + (5 \times 9)$
$= 630 + 45 = 675$</td></tr>
<tr><td>Some students will likely multiply 75 by 10 and then subtract a group of 75 from the result. You can model this line of thinking on a ratio table.
$$\begin{array}{r|l} 1 & 75 \\ \hline 10 & 750 \\ \hline 9 & 675 \end{array} \qquad \times 10,\ -1 \ /\ \times 10,\ -75$$
$75 \times 1 = 75$
$75 \times 10 = 750$
$75 \times 9 = 675$</td></tr>
</table>

- Model multiplication strategy of using fractions as operators.

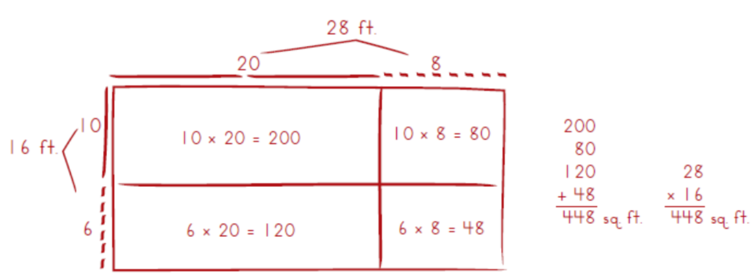
Problems	Sample Strategies & Recording
0.25 × 8	Strategies students might suggest for solving this problem include thinking in terms of 8 quarters or thinking of 0.25 as ¼, and cutting 8 in half once and then once again. Both strategies can be modeled on ratio tables. ×4 ×2: 1 | 4 | 8 / 0.25 | 1 | 2 (×4 ×2) 0.25 × 1 = 0.25 0.25 × 4 = 1 0.25 × 8 = 2 ÷2 ÷2: 1 | $\frac{1}{2}$ | $\frac{1}{4}$ / 8 | 4 | 2 (÷2 ÷2) 8 × 1 = 8 8 × $\frac{1}{2}$ = 4 8 × $\frac{1}{4}$ = 2
26 × 8	Look for a student who used the results of the previous problem to solve this one, reasoning that if 0.25 × 8 is 2, then 25 × 8 must be 200, and 26 × 8 would be 200 + 8, or 208. × 100 25 + 1 0.25 | 25 | 1 | 26 2 | 200 | 8 | 208 × 100 200 + 8
0.26 × 8	Some students may suggest using the results of the previous problem and dividing them by 100 to reflect the fact that 0.26 is 100 times smaller than 26. ÷ 100 26 | 0.26 208 | 2.08 ÷ 100 You can also challenge students to think about how they might use the results of the first problem in the string (0.25 × 8) to help solve this one. × 0.25 1 | 8 × 0.25 0.25 + 0.01 0.25 | 2 2 + 0.08 0.01 | 0.08 0.26 | 2.08

Week Three:

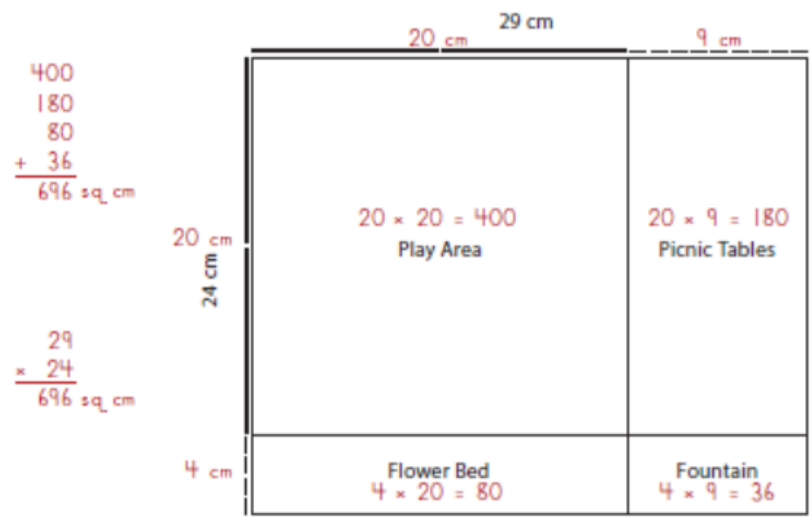
- Review and model partial products using an area model and array.

Examples:

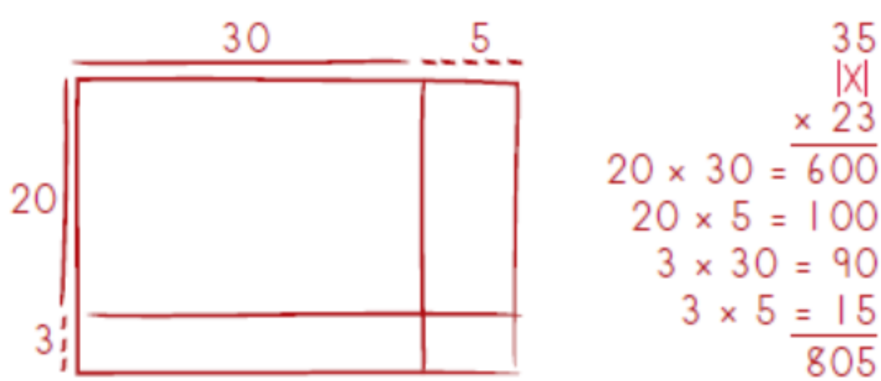
➢



➢ There is a patch of dirt near the sandbox that measures 24 by 29 cm. The ladybugs want to divide it into different sections as shown below. Use a multiplication equation to label each section. Then find the total area of the 24 by 29 cm patch.



- Model the transition from the area model and array to the algorithm.

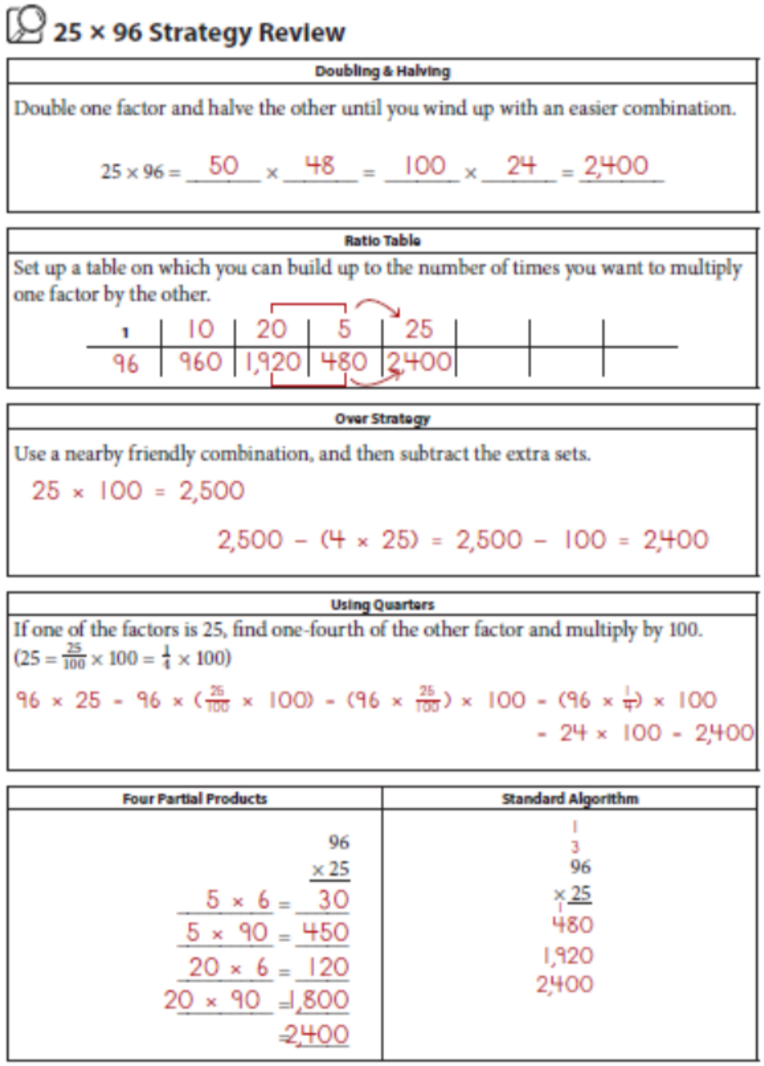


- Model and formally instruct the standard algorithm of multiplication.

Step	Computation
1	5 47 × 28 6
2	5 47 × 28 376
3	1 ~~5~~ 47 × 28 376 40
4	1 ~~5~~ 47 × 28 376 940
5	1 ~~5~~ 47 × 28 376 + 940 1,316

Week Four:

- Continue modeling and practicing the standard algorithm of multiplication.
- Review all strategies of multiplication.



25 × 96 Strategy Review

Doubling & Halving

Double one factor and halve the other until you wind up with an easier combination.

$25 \times 96 = 50 \times 48 = 100 \times 24 = 2{,}400$

Ratio Table

Set up a table on which you can build up to the number of times you want to multiply one factor by the other.

1	10	20	5	25		
96	960	1,920	480	2,400		

Over Strategy

Use a nearby friendly combination, and then subtract the extra sets.

$25 \times 100 = 2{,}500$

$2{,}500 - (4 \times 25) = 2{,}500 - 100 = 2{,}400$

Using Quarters

If one of the factors is 25, find one-fourth of the other factor and multiply by 100.
($25 = \frac{25}{100} \times 100 = \frac{1}{4} \times 100$)

$96 \times 25 = 96 \times (\frac{25}{100} \times 100) = (96 \times \frac{25}{100}) \times 100 = (96 \times \frac{1}{4}) \times 100$
$= 24 \times 100 = 2{,}400$

Four Partial Products	Standard Algorithm
96×25: $5 \times 6 = 30$; $5 \times 90 = 450$; $20 \times 6 = 120$; $20 \times 90 = 1{,}800$; $= 2{,}400$	96×25: 480; $1{,}920$; $2{,}400$

- Apply the standard algorithm of multiplication and other multiplication strategies to solve real world problems

Examples:

- ➢ Connor is trying to drive his car less frequently. He started by figuring out how much he drives in a typical year. If Connor drives about 98 miles each week, how much does he drive in one year (52 weeks)?
- ➢ Taylor has a cupcake business. She packages cupcakes in cartons that hold 25 cupcakes. The Wildwood School ordered 184 cartons of Taylor's cupcakes. How many cupcakes did the Wildwood School order?
- ➢ Victoria signed up for a two-year cell phone plan. She will pay $37.50 a month for 24 months. How much will Victoria have paid at the end of her two-year plan?
- ➢ Aaron wants to visit Australia. He found a plane ticket for $2,150. If Aaron saves

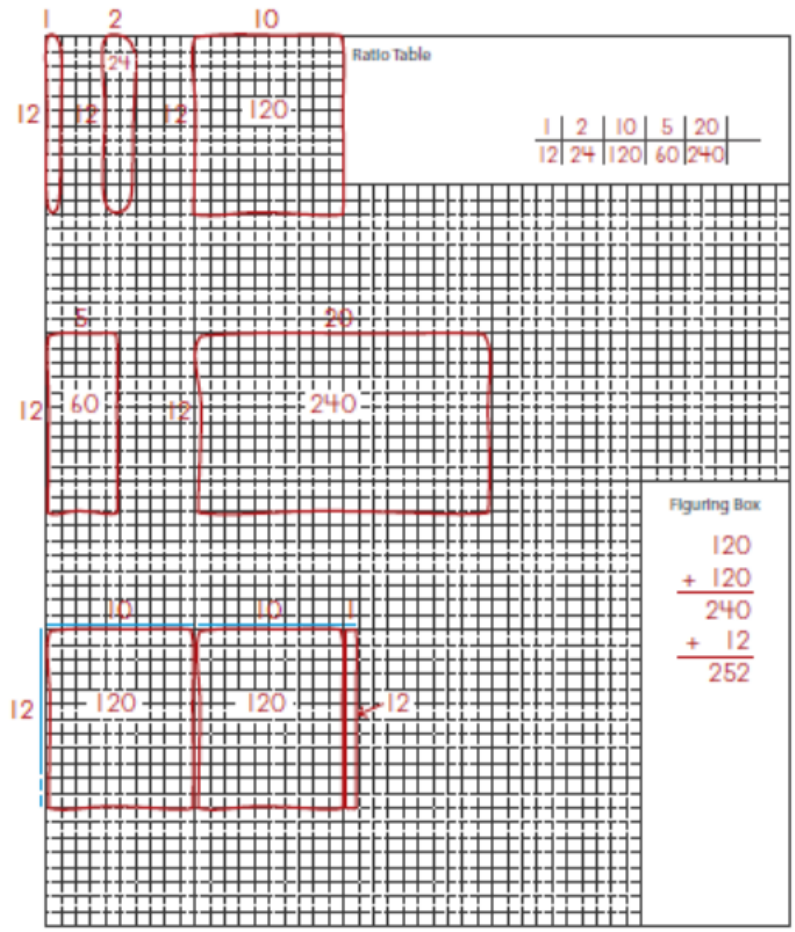
$86 a week, how many weeks will it take him to save enough money to go to Australia?

Week Five:

- Model division using rectangular arrays and ratio tables.

Example:

➢ Jason and his little brother have been collecting plastic toy dinosaurs for a couple of years. In all, they have 252 dinosaurs. Today, they decided to arrange their whole collection in columns of 12. How many columns were they able to make?

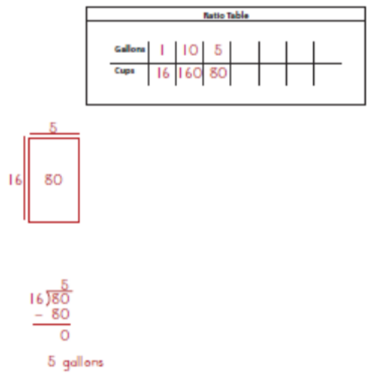


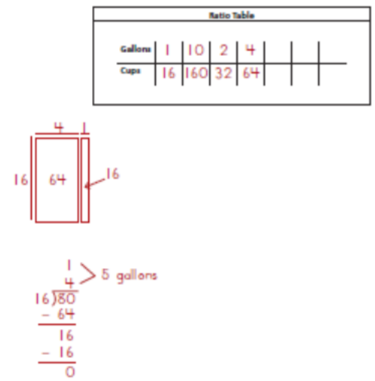
- Model how to track groups of a divisor subtracted from the dividend to divide using real world problems

Example:

➢ Have you ever thought about how much water you use each day? You might be surprised to find out how many gallons it takes to do even the simplest things. If you leave the tap running while you are brushing your teeth, you use about 80 cups of water. How many gallons is that?

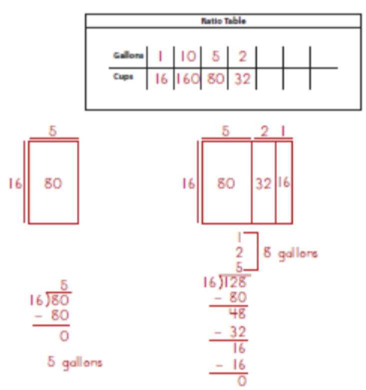
Possible solutions:

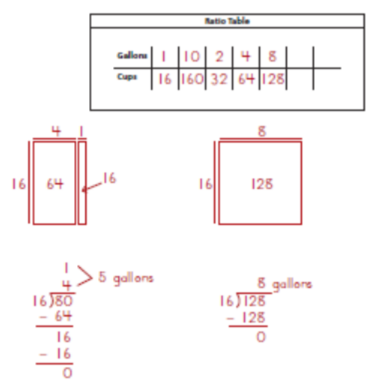




➢ If you wash your hands 4 times a day and leave the tap running while you wash, you use about 128 cups of water. How many gallons is that?

Possible solutions:





- Apply concepts of division to understand divisibility rules for 2, 3, 5, and 10

What does it mean when someone says, "6 is divisible by 2," or "11 is not divisible by 3"?

One number is divisible by another if you can divide it and there's no remainder. Like 8 is divisibe by 2, and 13 is not divisible by 2.

2	5	10
2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 24, 32, 46 100, 1,000, 1,200	5, 10, 15, 20, 25, 50, 100, 125, 150, 1,000 1010, 1,005	10, 20, 30, 40, 50, 60, 70, 100, 200, 350 500 1,000, 10,000

A number is divisible by 2 if …

it's even.

it's a multiple of 2.

it ha a 0, 2, 4, 6, or 8 in the ones place.

A number is divisible by 5 if …

it's a multiple of 5 or 10.

it has a 0 or a 5 in the ones place.

A number is divisible by 10 if …

it's a multiple of 10 (some multiples of 5 work too, but not all of them).

it has a 0 in the ones place.

- Develop understanding of remainders in division

Example:

332 ÷ 5

Ratio table for: 5

Number of Groups	1	10	20	30	40	60	8
Total	5	50	100	150	200	300	40

```
      6 ]
     60 ]  66 R2
  5)332
  - 300
     32
   - 30
      2
```

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Checkpoints
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 5: Multiplying and Dividing Fractions
Pacing	Five weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.NF.A.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad+bc)/bd.)*

5.NF.A.2 Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.*

5.NF.B.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.

a. Interpret the product $(a/b) \times q$ as a part of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show $(2/3) \times 4 = 8/3$, and create a story context for this equation. Do the same with $(2/3) \times (4/5) = 8/15$. (In general, $(a/b) \times (c/d) = (ac)/(bd)$.*
b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles and represent fraction products as rectangular areas.

5.NF.B.5 Interpret multiplication as scaling (resizing), by:
a. Comparing the size of a product to the size of one factor based on the size of the other factor, without performing the indicated multiplication.
b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1.

5.NF.B.6 Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

5.NF.B.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.
a. Interpret division of a unit fraction by a non-zero whole number and compute such quotients. *For example, create a story context for $(1/3) \div 4$, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that $(1/3) \div 4 = 1/12$ because $(1/12) \times 4 = 1/3$.*
b. Interpret division of a whole number by a unit fraction and compute such quotients. *For example, create a story context for $4 \div (1/5)$, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that $4 \div (1/5) = 20$ because $20 \times (1/5) = 4$.*
c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb. of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?*

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*

Students will be able to:	*Students will know/understand:*
• Solve multiplication of fractions problems using the area model and arrays	• Difference between multiplication and division of fractions • Models for multiplying and dividing fractions • Effect of the size of a fractional factor on a product
• Solve multiplication of fractions problems using the standard algorithm with and without context	• Difference between multiplication and division of fractions • Standard algorithm for multiplication of fractions • Effect of the size of a fractional factor on a product
• Calculate the fractional amount of a whole number	• Standard algorithm for multiplication of fractions • Effect of the size of a fractional factor on a product
• Convert between mixed numbers and improper fractions	• Improper fractions/mixed number conversion
• Solve division of fractions problems using a model	• Difference between multiplication and division of fractions • Models for multiplying and dividing fractions • Division of unit fraction by whole number • Division of whole number by unit fraction
• Solve division of fractions problems involving a whole number and a unit fraction using the standard algorithm with and without context	• Models for dividing fractions • Improper fractions/mixed number conversion • Division of unit fraction by whole number • Division of whole number by unit fraction
• Identify the correct operation (multiplication or division) to solve word problems involving fractions	• Difference between multiplication and division of fractions • Improper fractions/mixed number conversion • Standard algorithm for multiplication of fractions

	• Division of unit fraction by whole number • Division of whole number by unit fraction

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are multiplying and dividing fractions useful?	1. Multiplying and dividing fractions can be applied to real-world problem solving like measurement, scientific calculations, and data and statistics.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Bridges in Mathematics Grade 5 Unit 5 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 5 Mathematics - Multiply Fractions, Divide Fractions
- Math Learning Center apps for Grade 5 Unit 5

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- Multiply: to find the product of
- Dimension: the length, width, or height of a figure
- Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation
- Algorithm: a step-by-step procedure for computing that gives the correct result in every case when the steps are carried out correctly
- Factor: a number that divides evenly into another number
- Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array
- Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs
- Area: the total number of square units needed to cover a two-dimensional surface
- Square Unit: a square with sides that measure 1 unit, used to measure area.
- Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference
- Array: an arrangement consisting of equal rows and equal columns
- Divide: to break or split into equal parts; to determine how many times one number goes into another
- Quotient: the result or answer in division; the number of times one quantity goes into another
- Equation: a mathematical statement asserting that two quantities have the same value
- Area model of multiplication: a model in which two numbers being multiplied are represented by the dimensions of a rectangle, and their product is represented by the area of the rectangle.
- Fraction: a number expressed as some number of equal parts of a whole
- Denominator: the bottom number in a fraction, which shows into how many equal parts

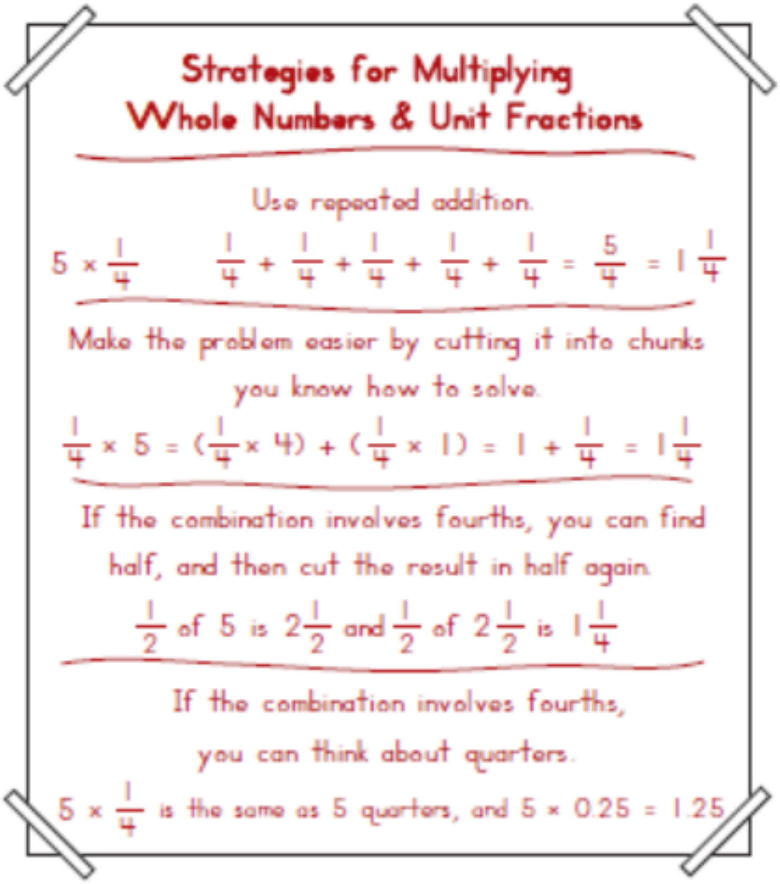
the whole is divided; also, the divisor

- <u>Numerator</u>: the top number in a fraction, which shows how many equal parts are to be counted; also, the dividend
- <u>Equivalent Fractions</u>: two or more different fractions that represent the same quantity.
- <u>Improper Fraction</u>: a fraction greater than 1 that is not expressed as a mixed number; a fraction in which the numerator is larger than the denominator.
- <u>Mixed Number</u>: a number greater than 1 expressed as a whole number plus a fraction whose value is less than 1
- <u>Unit Fraction</u>: a fraction with a numerator of 1
- <u>Rectangle</u>: a two-dimensional (flat) shape with two pairs of parallel sides (4 sides total) and 4 right angles
- <u>Whole Number</u>: a number such as 0, 1, 2, 3; one of the positive integers or 0
- <u>Associative Property of Multiplication</u>: the property by which the product remains unchanged no matter how the numbers being multiplied are grouped, so that $(a \times b) \times c = a \times (b \times c)$
- <u>Commutative Property of Multiplication</u>: the property by which the product remains unchanged no matter how the numbers being multiplied are ordered, so that $a \times b = b \times a$

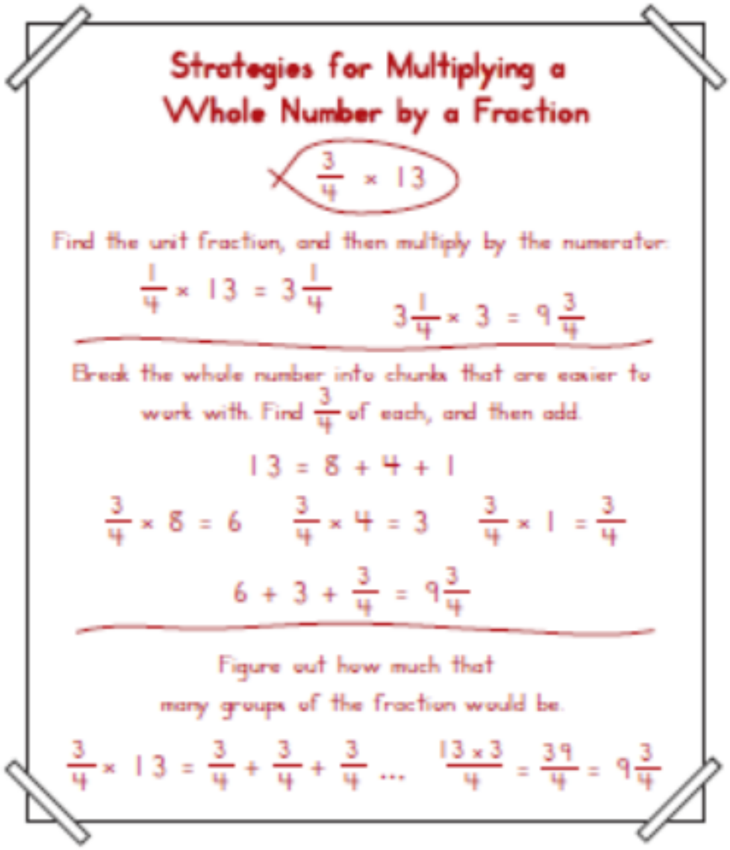
Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students use a variety of strategies including area models, arrays, and the standard algorithm to multiply and divide fractions. Students then apply the strategies to solve problems involving multiplying a whole number by a fraction and multiplying and fraction by fraction. Students are introduced to division of fractions by modeling and solving problems involving whole numbers by unit fraction and unit fraction by whole number. They extend these strategies and models to solve a variety of real-world problems.
Learning Tasks

Week One:

- Model strategies for multiplication of whole number and unit fractions



- Model strategies for multiplication of a whole number by a fraction



- Apply strategies to solve problems with multiplication of whole numbers and fractions.

Examples:

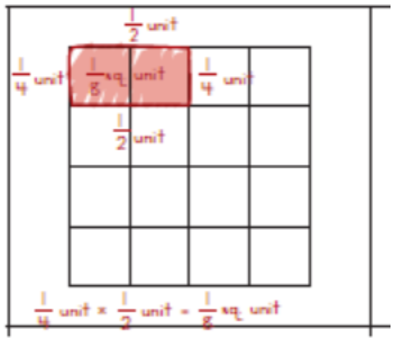
- If Ryan gives ¼ of his 48 baseball cards to Anna, how many cards does he give Anna?
- If Ryan gives 3/8 of his 48 baseball cards to Josiah, how many cards does he give Josiah?
- Theo entered a race that required him to ride his bike 54 kilometers and run 1/6 as far as he bikes. How many kilometers will Theo run?

Week Two:

- Use the area model to multiply fractions.

Example:

¼ x ½



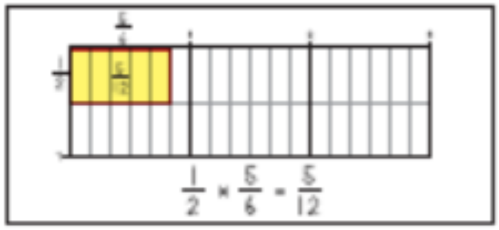
- Apply the area model strategy to solve problems.

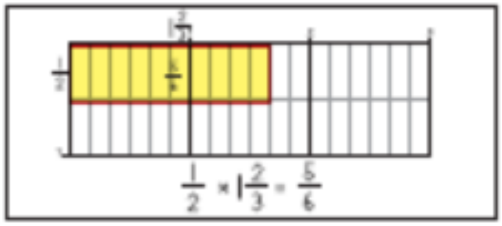
Examples:

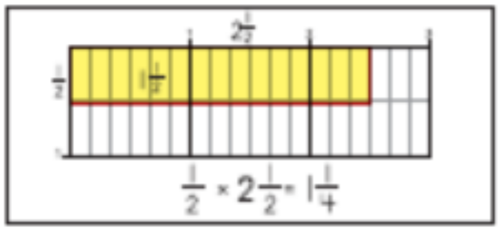
There was a price tag on Isabel's new book that was $\frac{1}{4}$ inch wide and $\frac{3}{4}$ inch long. What was the area of the price tag?

$\frac{1}{2} \times \frac{1}{8}$

- Model multiplication of fraction and whole number, fraction and mixed number, and fraction and fraction using arrays







- Solve real world problems involving multiplying fractions.

Examples:

- Mark and 2 of his friends were playing at the park. His mom brought them lunch, but she didn't know how many kids were at the park, so she only brought 2 sandwiches. Mark and his friends want to share the sandwiches equally. If Mark and his friends share the 2 sandwiches equally, how much of a sandwich does each person get?

- On Monday, Mr. Smith bought a gallon of milk for his family. On Wednesday, there was only ¼ of a gallon left. His son drank 2/3 of the remaining milk for breakfast. How much of the gallon of milk was left?

- Sally lives ¾ of a mile from school, and she walks to school each day. One morning, she was late, so she ran part of the way. She ran 2/3 of the way to school before she got too tired, and then she walked the rest of the way. How much of a mile did she run?

Week Three:

- Use the standard algorithm for multiplication of fractions.

$$\frac{1}{2} \times \frac{2}{3} = \frac{(1 \times 2)}{(2 \times 3)} = \frac{2}{6}$$

- Convert between mixed numbers and improper fractions.

- Make generalizations involving multiplying by a fraction less than one vs. multiplying by a fraction greater than one.

When you multiply two fractions that are less than 1, the product will always be less than 1. The product will also be less than both of the fractions you are multiplying.

$$\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$$

$$\frac{3}{8} < \frac{1}{2} \text{ and } \frac{3}{8} < \frac{3}{4}$$

When you multiply a whole number or a mixed number by a fraction, the product will be less than the whole number. The product will also be greater than the fraction.

$$\frac{1}{3} \times 1\frac{1}{3} = \frac{1}{3} \times \frac{4}{3} = \frac{4}{9}$$

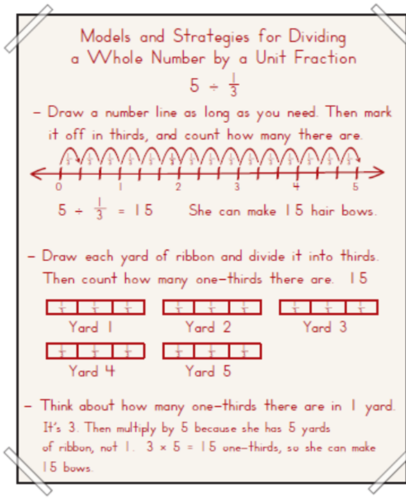
$$\frac{4}{9} > \frac{1}{3} \text{ and } \frac{4}{9} < 1\frac{1}{3}$$

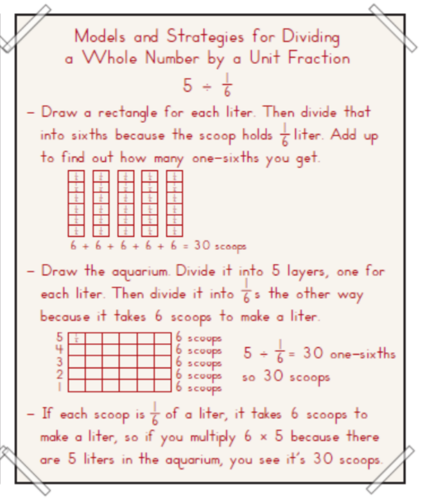
- Solve real world problems involving multiplication of fractions, whole numbers, and mixed numbers.

Week Four:

- Review concepts of division as grouping or sharing with whole numbers

- Model strategies for dividing a whole number by a unit fraction.



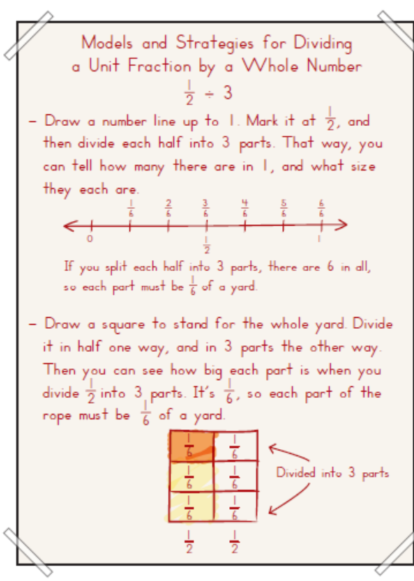


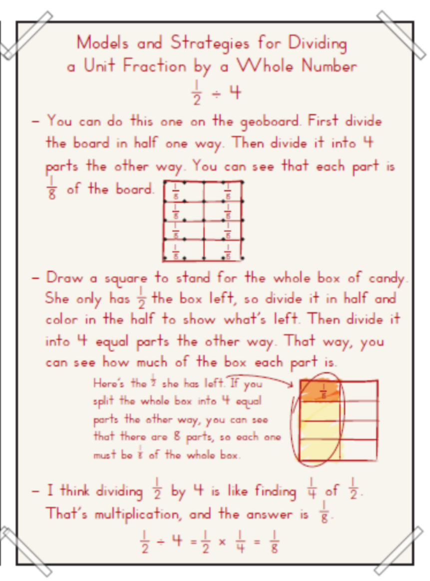
- Solve problems dividing a whole number by a unit fraction using real world examples.

Examples:

  - How many ½ cup servings are there in 6 cups of ice cream?
  - It takes 1/3 of a yard of ribbon to make a hair bow. Maya has 5 yards of ribbon. How many hair bows can she make?
  - Our aquarium holds 5 liters of water. If we use a scoop that holds 1/6 of a liter of water, how many scoops will be needed to fill the aquarium?

- Model strategies for dividing a unit fraction by a whole number.





- Solve problems involving division of a unit fraction by a whole number using real world examples.

Examples:

  - There is ¼ of a pan of brownies left. Jake and his 3 brothers are going to share the brownies equally. What fraction of the pan of brownies will each of the four boys get?

  - John has ½ of a yard of rope. He wants to cut the rope into 3 equal pieces. What fraction of a yard is each piece of rope?

Week Five:

- Solve real world problems involving multiplication and division of fractions that require students to determine the correct operation and write an expression or equation

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

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Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Checkpoints • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 6: Graphing, Geometry, and Volume
Pacing	Five weeks

CT Core Standards *What are the goals of this unit?*

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.OA.B.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so*.

5.MD.C.5 Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.

a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.

b. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.

c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

5.G.A.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis, and y-coordinate).

5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpret coordinate values of points in the context of the situation.

5.G.B.3 Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.

5.G.B.4 Classify two-dimensional figures in a hierarchy based on properties.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Plot and identify coordinates on a grid	*Students will know/understand:* • Coordinate plane • Coordinates
• Describe polygons by their properties and characteristics	• Properties and characteristics of polygons • Name polygons • Hierarchy of polygons based on characteristics
• Name polygons based on their characteristics	• Properties and characteristics of polygons • Name polygons

	• Hierarchy of polygons based on characteristics
• Calculate the volume of a rectangular prism using the volume formula	• Volume formula
• Determine the missing dimension of a rectangular prism given the volume	• Volume formula

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are graphing coordinates, properties and characteristics of polygons, and volume useful?	1. Graphing coordinates, properties and characteristics of polygons, and volume can be applied to real-world problem solving like mapping, measurement, scientific calculations, and data and statistics.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:
- Bridges in Mathematics Grade 5 Unit 6 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:
- IXL Lessons- Grade 5 Mathematics, Coordinate Plane, Units of Measurement, Two Dimensional Figures, Triangles and Quadrilaterals, Three Dimensional Figures,

Geometric Measurement

- Math Learning Center apps for Grade 5 Unit 6

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- Multiply: to find the product of
- Dimension: the length, width, or height of a figure
- Factor: a number that divides evenly into another number
- Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs
- Area: the total number of square units needed to cover a two-dimensional surface
- Equation: a mathematical statement asserting that two quantities have the same value
- Rectangular Prism: a three-dimensional shape (solid) whose 6 faces are all rectangles.
- Volume: the total number of cubic units needed to fill a three-dimensional space
- Base: a face of a three-dimensional shape (solid), usually the face on which it stands
- Kite: a two-dimensional (flat) shape with two pairs of congruent adjacent sides
- Parallelogram: a two-dimensional (flat) shape with 4 sides, with both pairs of opposite sides parallel
- Perimeter: the distance in linear units around a two-dimensional (flat) figure; the perimeter of a circle is called the circumference
- Quadrilateral: a two-dimensional (flat) shape with 4 sides
- Rectangle: a two-dimensional (flat) shape with two pairs of parallel sides (4 sides total) and 4 right angles
- Rhombus: a two-dimensional (flat) shape with 4 congruent sides

- Coordinate Plane: a two-dimensional system in which a point is described by its distance from two perpendicular lines called axes.
- Coordinates: numbers used to identify the position of a point relative to the x and y-axes of the coordinate plane
- x-axis: the horizontal axis on a coordinate grid
- y-axis: the vertical axis on a coordinate grid
- Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement
- Angle: the figure formed by 2 rays or line segments that share an endpoint; often measured in terms of the amount of rotation (expressed as some number of degrees) needed to superimpose one of those rays or line segments onto the other
- Acute Angle: an angle with a measure greater than 0° and less than 90°
- Acute Triangle: a triangle with 1 acute angle (1 angle that measures less than 90°)
- Equilateral Triangle: a triangle with all sides the same length
- Isosceles Triangle: a triangle with exactly 2 congruent sides
- Obtuse Angle: an angle with a measure greater than 90° and less than 180°
- Obtuse Triangle: a triangle with 1 obtuse angle (1 angle that measures greater than 90° and less than 180°)
- Right Angle: an angle with a measure of exactly 90°
- Right Triangle: a triangle with 1 right angle (1 angle that measures exactly 90°)
- Congruent: of the same shape and size; two shapes are congruent if one can be exactly superimposed onto the other using a sequence of rotations, reflections, and/or translations
- Parallel: always the same distance apart
- Square: a two-dimensional (flat) shape with 4 congruent sides and 4 right angles
- Trapezoid: a two-dimensional (flat) shape with 4 sides, exactly 1 pair of which are parallel
- Hexagon: a two-dimensional (flat) shape with 6 sides

- Scalene Triangle: a triangle whose sides are all of different lengths.
- Pentagon: a two-dimensional (flat) shape with 5 sides
- Polygon: a closed two-dimensional (flat) shape with 3 or more sides
- Cube: a three-dimensional shape (solid) whose 6 faces are all squares
- Cubic Unit: a unit used to measure volume (e.g., cubic centimeter, cubic inch)
- Vertex: the point at which the sides of a two-dimensional (flat) shape or the edges of a three-dimensional shape (solid) intersect
- Edge: the line segment along which two faces of a three-dimensional shape (solid) meet
- Ratio: a comparison of two numbers using division, often expressed as a fraction

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students are introduced to the concepts of coordinate graphing. Students classify two-dimensional shapes based on their properties and understanding of hierarchies. Students review volume concepts and calculations. Students use standard measurements of rectangular prisms and formulas (V = (l x w) x h and V = B x h) to calculate volume or a missing dimension.
Learning Tasks

Week One:

- Model graphing ordered pairs and identifying the coordinates of a point on a graph.

- Graph real world examples using tables and coordinates.

Examples:

Anthony is a junior in high school. He decided to get a job this summer so he could put some money in his college savings account. His goal was to put $1,000 into his account, but still have time to rest up before school started again. He is a very good math student who loves computers, and he was lucky to be offered a summer job with two different software companies.

Company 1 offered to pay Anthony $1 on the first day and double the amount each day ($1 the first day, $2 the next day, $4 the third day, $8 the fourth day, and so on).

Company 2 offered to pay Anthony $75 every day.

Which job should Anthony accept if he wants to reach his goal of earning $1,000 as quickly as possible?

1 On the next page, fill in the table for each company's payment plan. You can stop as soon as the total amount of money reaches or goes over $1,000 for a plan, and then do the other one.

2 On the next page, graph the running totals for each day. Graph each plan in a different color, and mark the key at the bottom of the sheet to show which is which.

3 Which company's plan turned out to be best? Why?

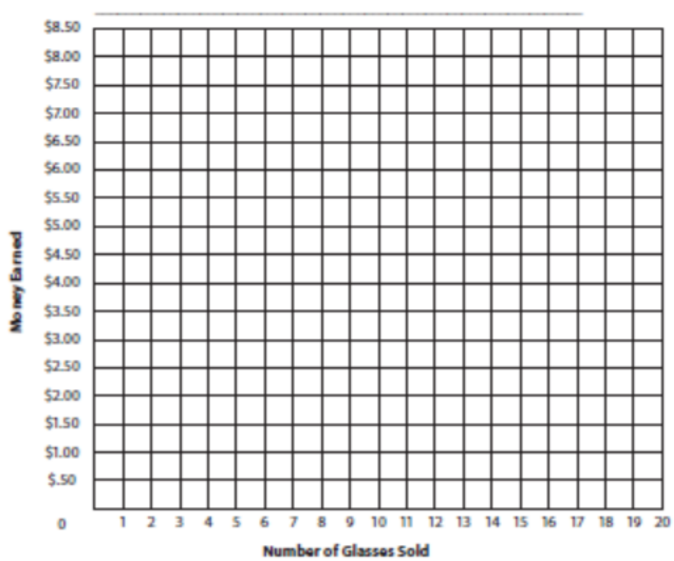
➢

Troy and his little sister are going to sell lemonade to earn money for the wildlife refuge near their home. Troy's parents have agreed to pay for the ingredients and the cups. The kids are going to charge 50¢ a glass for their lemonade.

1 Fill in the table below to show how much money they'll earn.

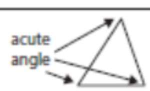
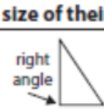
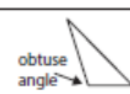
Number of glasses sold	1	2	3		5		7	8	9	
Money earned	$0.50		$1.50			$3.00				$5.00

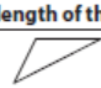
2 Use the grid below to graph the amount of money they'll earn as they sell glasses of lemonade. Give your graph a good title.



Week Two:

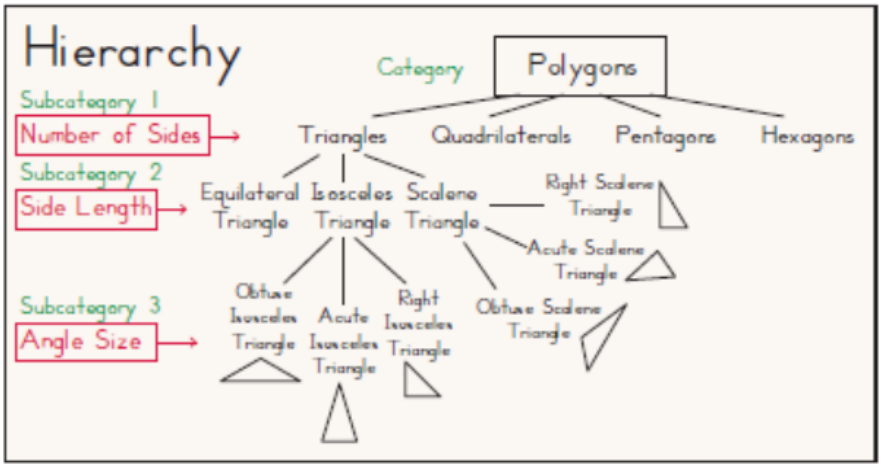
- Classify triangles by angle size and by side length.

by the size of their angles		
 **Acute Triangle** All 3 angles are acute.	 **Right Triangle** One of the angles is a right angle.	 **Obtuse Triangle** One of the angles is obtuse.

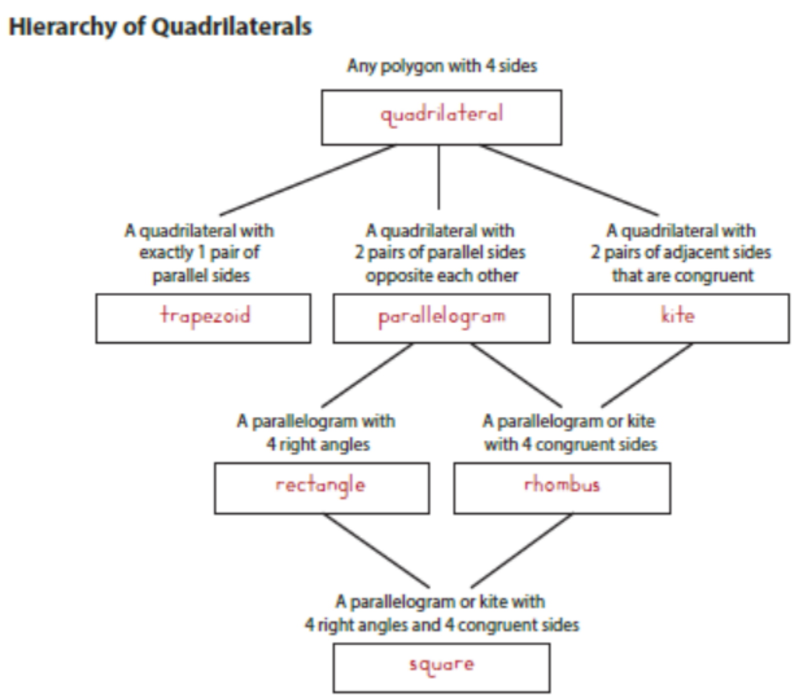
by the length of their sides		
 **Isosceles Triangle** Two sides are the same length.	 **Scalene Triangle** Each side is a different length.	 **Equilateral Triangle** All 3 sides are the same length.

- Introduce hierarchies using triangles.

Examples:

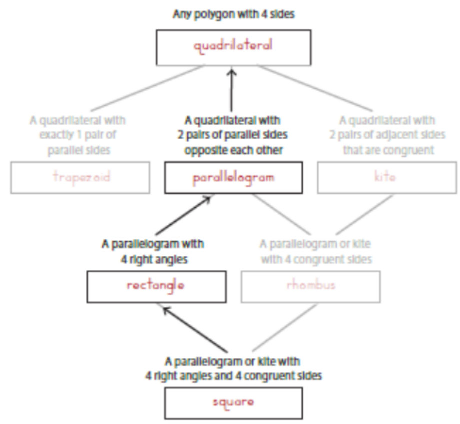


- Construct a hierarchy to understand properties of quadrilaterals.

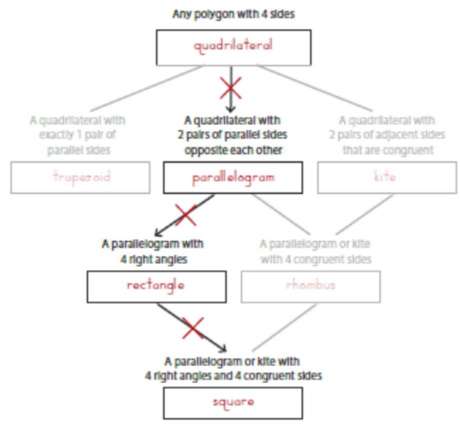


- Model use of the hierarchy to demonstrate that shapes in a subcategory share all the properties of the category, but the reverse is not true

Example:



This works. All squares are rectangles. All rectangles are parallelograms, and all parallelograms are quadrilaterals.



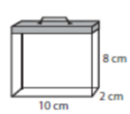
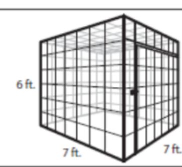
This does not work. All quadrilaterals are not parallelograms; some are trapezoids or kites. All parallelograms are not rectangles; some are rhombuses. All rectangles are not squares, some don't have 4 congruent sides.

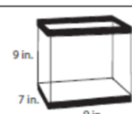
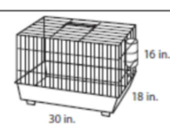
- Classify polygons based on properties.

Week Three:

- Calculate volume of a rectangular prism given three dimensions using the formula *volume = area of the base x height* or *volume = (length x width) x height*

Examples:

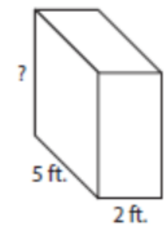
	
Equation	Equation
Ant Farm Volume	Dog Kennel Volume

	
Equation	Equation
Scorpion Tank Volume	Guinea Pig Cage Volume

- Calculate a missing dimension of a rectangular prism using its volume.

Example:

  - ➢ The volume of this rectangular solid is 40 cubic feet. What is its height?



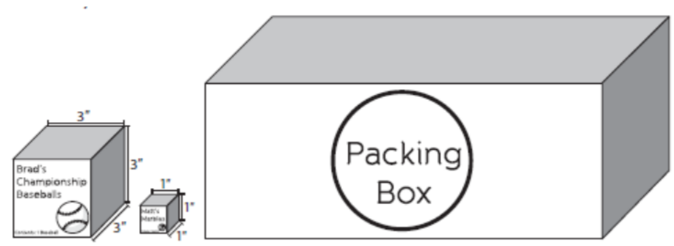
- Calculate volume or a missing dimension of a rectangular prism using real world problems.

Examples:

  - Matt measured the dimensions of a box and found that the area of the base is 16 square inches, and the height is 64 inches. What is the volume of the box?

  - Matt's friend, Franny, found the volume of a rectangular prism was 96 cubic inches. She remembered that the area of the base was 16 square inches. What was the height of the box?

  - Matt is ready to pack his marbles into large boxes that he got from Brad. The illustrations show the size of an individually wrapped baseball and an individually wrapped marble along with an example of a packing box. How many marbles will fit into each large box with the dimensions below? Show all work.



1 $2 \times 6 \times 6$

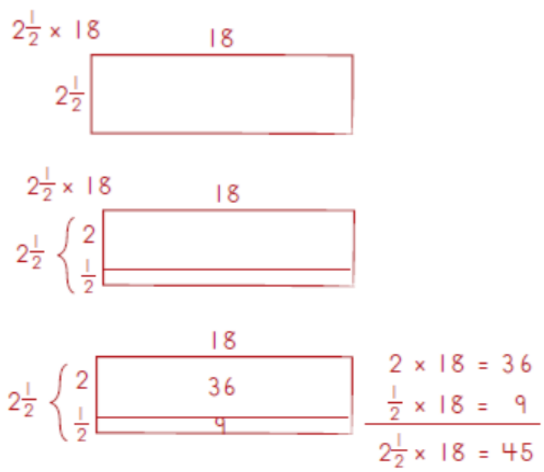
2 $2 \times 6 \times 12$

3 $4 \times 5 \times 3$

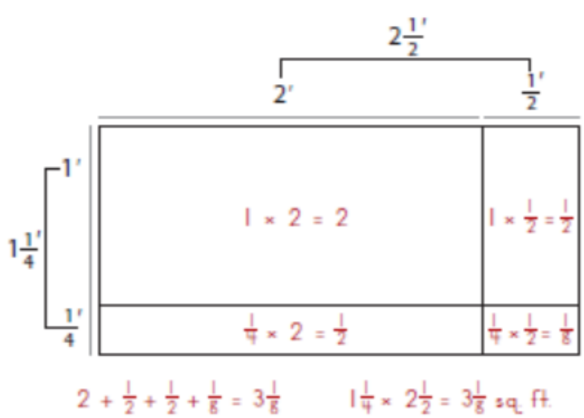
Week Four:

- Review area model of multiplication using mixed numbers.

Examples:

- 

- $1\frac{1}{4} \times 2\frac{1}{2}$



- Calculate area of rectangles with fractional dimensions using real world problems

Example:

- Ebony made a banner for Jada to hang on her door. The banner is 1 3/8 feet wide and 2 ¼ feet long. What is the area of the banner?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice

- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Checkpoints
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 5 Math
Unit of Study	Unit 7: Division and Decimals
Pacing	Five weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

5.OA.A.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

5.NBT.A.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

5.NBT.A.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

5.NBT.B.6 Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the

relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 5.NBT.B.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: • Divide unit fractions by whole numbers and whole numbers by unit fractions with and without context.	*Students will know/understand:* • Division using unit fractions • Partial products • Partial quotients • Ratio tables
• Write and solve division problems with unit fractions	• Division using unit fractions • Partial products • Partial quotients • Ratio tables
• Solve division problems with whole numbers using partial quotients	• Partial products • Partial quotients • Ratio tables • Remainders
• Multiply whole numbers and decimals by powers of ten	• Powers of ten and exponents • Place value of decimals • Multiplication and division with powers of ten
• Divide a 4-digit dividend by a 2 digit divisor	• Partial quotients • Ratio tables • Remainders
• Interpret the remainder in real world division	• Partial quotients

problem	• Ratio tables • Remainders
• Divide whole numbers and decimals by powers of ten	• Powers of ten and exponents
• Multiply decimals using an area model, partial products, and the standard algorithm	• Area model • Partial products • Standard algorithm for multiplication of decimals
• Divide decimals using arrays, ratio tables, and partial quotients	• Array • Ratio tables • Partial products • Partial quotients

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are dividing multi-digit whole numbers, decimals, and fractions useful?	1. Dividing multi-digit whole numbers, decimals, and fractions can be applied to real-world problem solving like money, measurement, scientific calculations, and data and statistics.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Bridges in Mathematics Grade 5 Unit 7 Student Book and Home Connections (for classwork/HW practice problems)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 5 Mathematics, Division, Multiply Decimals, Divide Decimals, Divide Fractions, Money
- Math Learning Center apps for Grade 5 Unit 7

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

*Definitions from Bridges in Mathematics Word Resource Cards

- Dimension: the length, width, or height of a figure
- Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation
- Product: the result of multiplying two or more numbers; in the array model, the product is the area of the array
- Expression: one or more mathematical symbols that represent a number or quantity; expressions do not include equality or inequality signs
- Area: the total number of square units needed to cover a two-dimensional surface
- Array: an arrangement consisting of equal rows and equal columns
- Ratio Table: a model that represents equivalent ratios; can be used as a tool to solve problems that involve multiplication, division, fractions, and proportions
- Divide: to break or split into equal parts; to determine how many times one number goes into another
- Dividend: the number that will be divided in a division problem
- Divisor: the number in a division problem that divides the dividend
- Quotient: the result or answer in division; the number of times one quantity goes into another
- Equation: a mathematical statement asserting that two quantities have the same value

- Decimal: relating to powers of 10; also, a fraction with a denominator that is a power of 10, often expressed using digits and a decimal point
- Remainder: the number left over when a whole number is divided by another whole number
- Whole Number: a number such as 0, 1, 2, 3; one of the positive integers or 0
- Operation: any procedure—such as addition, subtraction, multiplication, and division—in which numbers are acted upon according to a set of rules
- Parentheses: curved marks used to group mathematical symbols ( )
- Ratio: a comparison of two numbers using division, often expressed as a fraction
- Unit Fraction: a fraction with a numerator of 1
- Pattern: a collection of numbers, shapes, or objects that forms a consistent or characteristic arrangement
- Fraction: a number expressed as some number of equal parts of a whole
- Exponent: a number or symbol that indicates the power to which the base number is raised; for example, in this expression, the exponent 2 indicates that 3 is raised to the second power: $3^2 = 3 \times 3$
- Hundredth: one of 100 equal parts of a whole (1⁄100 or 0.01)
- Tenth: 1 of 10 equal parts of a whole (1⁄10 or 0.1)
- Estimate: a close guess of the actual value, usually based on some thought or rough calculation; to make an approximate or rough count, measurement, or calculation
- Thousandth: 1 of 1,000 equal parts of a whole (1⁄1000 or 0.001)

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students use the division strategy of partial quotients and equivalent ratios to divide 4-digit dividends by 2-digit divisors. Students divide whole numbers by unit fractions with and without context. Students interpret division problems using concepts of sharing or grouping. Students solve problems that require context to write division expressions and equations and interpret remainders. Students recognize patterns of multiplying and dividing whole numbers and decimals by powers of ten.

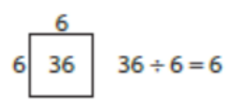
Learning Tasks

Week One:

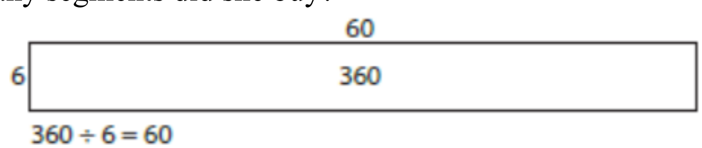
- Model division with whole numbers up to 3 digits by 2 digit numbers using partial products and place value and powers of ten

Examples:

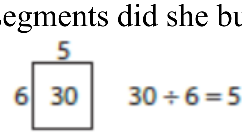
- Maya loves going to the scrapbooking store to buy stickers for her collection. All of the stickers in the store are on rolls hanging on the wall. The rolls have different numbers of stickers in each segment, based on the size of the sticker, and customers pay for the number of segments they purchase.
    - Maya bought 36 stickers from a roll that had 6 stickers in each segment. How many segments did she buy?



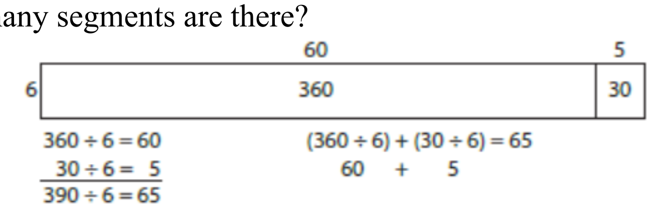
    - Maya bought 360 stickers from a roll that had 6 stickers in each segment. How many segments did she buy?



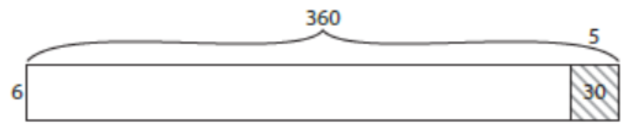
    - Maya bought 30 stickers from a roll that had 6 stickers in each segment. How many segments did she buy?



    - If there are 390 stickers on a roll and there are 6 stickers in each segment, how many segments are there?



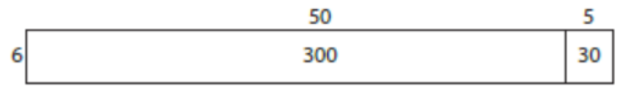
    - $330 \div 6$



$(360 \div 6) - (30 \div 6) = 330 \div 6 = 55$

$60 \quad - \quad 5 \quad = \quad 55$

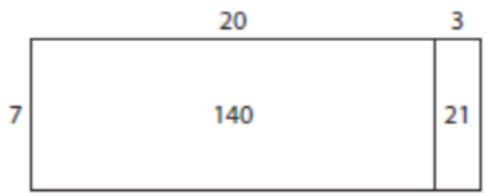
OR



$(300 \div 6) + (30 \div 6) = 330 \div 6 = 55$

- $161 \div 7$

$161 = 140 + 21$

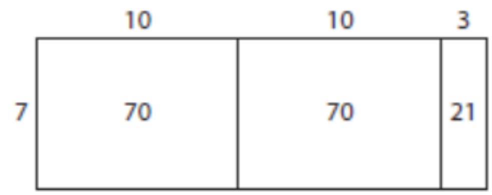


$$\begin{array}{r} 140 \div 7 = 20 \\ 21 \div 7 = \ \ 3 \\ \hline 161 \div 7 = 23 \end{array}$$

$(140 \div 7) + (21 \div 7)$

$20 + 3$

$161 = 70 + 70 + 21$



$$\begin{array}{r} 70 \div 7 = 10 \\ 70 \div 7 = 10 \\ 21 \div 7 = \ \ 3 \\ \hline 161 \div 7 = 23 \end{array}$$

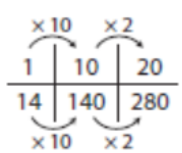
$(70 \div 7) + (70 \div 7) + (21 \div 7)$

$10 \quad + \quad 10 \quad + \quad 3$

- Model division with whole numbers up to 4 digit dividends by 2 digit divisors using equivalent ratios and ratio tables

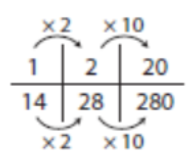
Examples:

- $280 \div 14$



$280 \div 14 = 20$

$20 \times 14 = 280$



$280 \div 14 = 20$

$20 \times 14 = 280$

- $308 \div 14$

$20 + 2$

1	20	2	22
14	280	28	308

$280 + 28$

$308 \div 14 = 22$
$22 \times 14 = 308$

- $252 \div 14$

$20 - 2$

1	2	20	18
14	28	280	252

$280 - 28$

$$\begin{array}{r} 280 \div 14 = 20 \\ -\ 28 \div 14 = \ \ 2 \\ \hline 252 \div 14 = 18 \end{array}$$

$(280 \div 14) - (28 \div 14)$
$20 - 2$

$18 \times 14 = 252$
$252 \div 14 = 18$

- $2800 \div 14$
  - *Make connection to* $\boxed{28 \div 14}$ *or* $\boxed{280 \div 14}$

- $3052 \div 14$

Week Two:

- Investigate and model rate using division and equivalent ratios.

Example:

Lisa's parents own a bakery. They sell fruit pizzas made of granola crust with yogurt filling and one fruit topping. Many fruit topping choices are available.

Lisa wants to make a few fruit pizzas to eat with her friends, and she needs to figure out how much fruit to buy for each kind of pizza she makes. She found a chart that her parents made for their latest pizza order that shows how much of each kind of fruit was used on different numbers of pizzas.

Use the information on the chart below to help Lisa figure out how many cups of fruit she would need for each different kind of pizza, so she can decide if she wants to make a blueberry pizza, a strawberry pizza, a peach pizza, or some of the other kinds on the list.

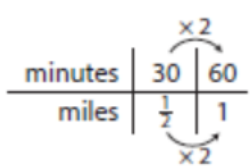
Note: The cups of fruit are divided evenly among the number of pizzas for that kind of fruit.

Fruit Used for Pizzas			
Type of Fruit	**Cups of Fruit**	**Number of Pizzas**	**Cups of Fruit per Pizza**
blueberries	237	79	
strawberries	352	88	
peaches	91	182	
blackberries	176	44	
kiwi	42	28	
raspberries	88	22	
mandarin oranges	120	48	
grapes	1	$\frac{1}{4}$	
pineapple	2	$\frac{1}{2}$	
mango	1	$\frac{1}{3}$	

- Model equivalent ratio strategy for division with whole numbers and unit fractions

Examples:

- If a student walked ½ mile in 30 minutes, how fast was he walking? What is his pace per mile?



- If a student walked ¼ mile in 5 minutes, how fast was she walking? What is her pace, per mile?

minutes	5	20
miles	$\frac{1}{4}$	1

minutes	5	10	20
miles	$\frac{1}{4}$	$\frac{1}{2}$	1

- Solve division problems with equivalent ratios using real world problems.

Examples:

- The Sellwood Community Center wants to donate hot dogs to the Southeast Portland Food Project, and they want to find the best deal.

  1 At Food Mart, hot dogs can be purchased in packages of 8 for \$2.40 or packages of 12 for \$3.00. Which is a better buy? Explain how you know.

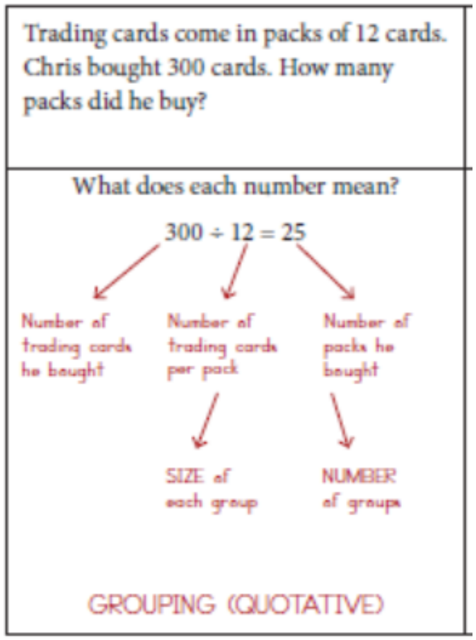
  2 At Food World, hot dogs are sold in packages of 24 for \$5.76 or packages of 50 for \$12.00. Which is a better buy? Explain how you know.

  3 The community center organizers want to buy 600 hot dogs. What will the cost be if they purchase the packages with the best buy? Show your thinking.

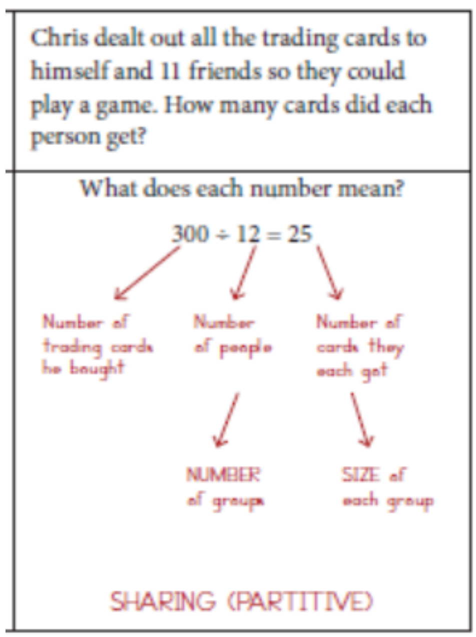
- Alice is filling cupcake molds with old, melted crayons to make new crayons for her brother's party. If it takes her 9 minutes to fill ¼ of the molds, how long will it take her to fill all the molds?

Week Three:

- Model division in a grouping context



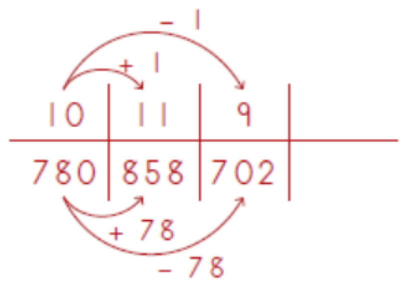
- Model division in a sharing context



- Solve division problems using the strategy of over or under landmark numbers.

Examples:

$858 \div 78$ $\qquad$ $702 \div 78$



Over Strategy:

$$\begin{array}{r} 10 \times 78 = 780 \\ +\ \ 1 \times 78 = \ \ 78 \\ \hline 11 \times 78 = 858 \end{array}$$

$$\begin{array}{r} 780 \div 78 = 10 \\ +\ \ 78 \div 78 = \ \ 1 \\ \hline 858 \div 78 = 11 \end{array}$$

Under Strategy:

$$\begin{array}{r} 10 \times 78 = 780 \\ -\ \ 1 \times 78 = \ \ 78 \\ \hline 9 \times 78 = 702 \end{array}$$

$$\begin{array}{r} 780 \div 78 = 10 \\ -\ \ 78 \div 78 = \ \ 1 \\ \hline 702 \div 78 = \ \ 9 \end{array}$$

- Interpret remainders of real-world division problems

Examples:

- A bakery donated 273 cookies for the end of the year fifth grade school party. How many cookies does each of the 84 students get if they share the cookies fairly?
- There are 814 students going on a field trip, and they have 31 buses. How many students should go on each bus if they split up evenly on the buses?
- During a play, 744 students will sit in rows in the auditorium. If each row can seat 32 students, how many rows do they need?
- Mrs. Smith's class has 24 students. The tickets to the symphony for her class cost $162. How much would each student's ticket cost if the teacher gets a free ticket?
- Olivia made brownies for her class. There are 24 students in her class. She made 30 brownies and divided them equally. How many brownies did each student get?

Week Four:

- Solve problems multiplying and dividing by powers of ten while introducing exponent notation and recognizing patterns.

Problems	Sample Strategies & Recording	Connections
$64{,}000 \div 10^2$	$64{,}000 \div 10^2 = 64{,}000 \div (10 \times 10) = 64{,}000 \div 100 = 640$	
$64{,}000 \div 10^3$	$64{,}000 \div 10^3 = 64{,}000 \div (10 \times 10 \times 10) = 64{,}000 \div 1{,}000 = 64$	
4.5×10^1	$4.5 \times 10^1 = 4.5 \times 10 = 45$	**Big Idea** When a decimal number is multiplied by a power of 10, the decimal point can be seen to shift to the right by the number of places equal to the number zeros in the multiplier. For example, $4.5 \times 10^1 = 45$ while $4.5 \times 10^2 = 450$. Conversely, when a decimal number is divided by a power of 10, the decimal point shifts to the left by the number of places equal to the number of zeros in the divisor. For example, $2.7 \div 10^1 = 0.27$ while $2.7 \div 10^2 = 0.027$.
4.5×10^2	$4.5 \times 10^2 = 4.5 \times (10 \times 10) = 4.5 \times 100 = 450$	
4.5×10^3	$4.5 \times 10^3 = 4.5 \times (10 \times 10 \times 10) = 4.5 \times 1{,}000 = 4500$	
$2.7 \div 10^1$	$2.7 \div 10^1 = 2.7 \div 10 = 0.27$	
$2.7 \div 10^2$	$2.7 \div 10^2 = 2.7 \div (10 \times 10) = 2.7 \div 100 = 0.027$	
$2.7 \div 10^3$	$2.7 \div 10^3 = 2.7 \div (10 \times 10 \times 10) = 2.7 \div 1{,}000 = 0.0027$	

- Solve problems multiplying by powers of ten with decimals and fractions and recognize patterns.

Example:

- The post office sells 1¢ stamps. Fill out the table below to show how much it would cost to buy different quantities of 1¢ stamps.

Number of Stamps	Decimal Equation	Fraction Equation	Total Cost
1 stamp	$1 \times 0.01 = 0.01$	$1 \times \frac{1}{100} = \frac{1}{100}$	\$0.01
2 stamps	$2 \times 0.01 = 0.02$	$2 \times \frac{1}{100} = \frac{2}{100}$	\$0.02
10 stamps			
20 stamps			
45 stamps			
321 stamps			
404 stamps			

- Solve problems dividing by powers of ten as decimals and fractions and recognize patterns.

Example:

- Amelia feeds her pet lizard crickets. The pet store sells crickets for 10 cents each. If Amelia spent \$1.30 on crickets last week, how many crickets did she buy?

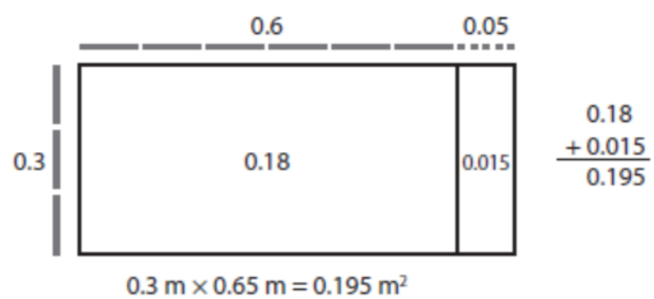
Fill out the table below to show how much it would cost to buy different quantities of crickets.

Total Cost	Decimal Equation	Fraction Equation	Number of Crickets
\$0.10	$0.10 \div 0.10 = 1$	$\frac{1}{10} \div \frac{1}{10} = 1$	1 cricket
\$0.20	$0.20 \div 0.10 = 2$	$\frac{2}{10} \div \frac{1}{10} = 2$	2 crickets
\$1.00			
\$2.00			
\$3.30			
\$5.20			

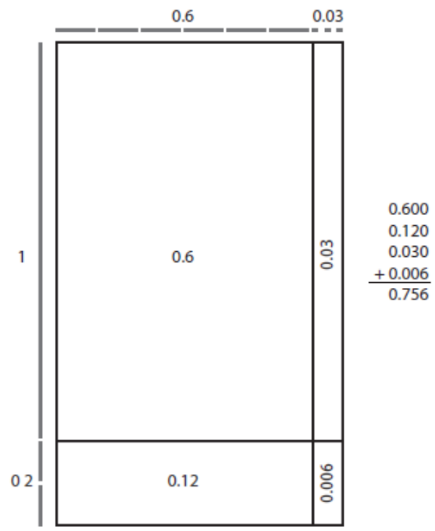
Week Five:

- Solve problems with multiplying decimals using the area model, partial products, and the standard algorithm.

Examples:



Problem 1: Area of a Piece of Paper Measuring 0.3 m × 0.65 m = 0.195 sq. m

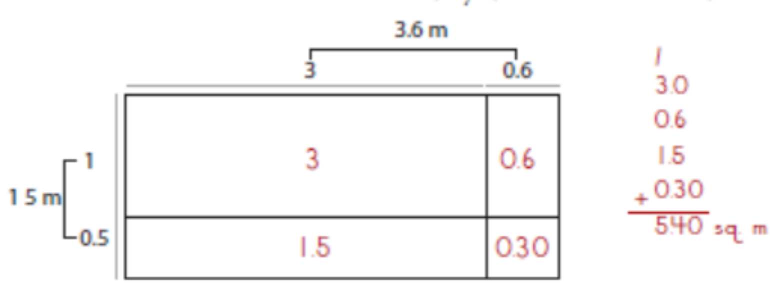


1.2 km × 0.63 km = 0.756 km²

Problem 2: Area of a City Park Measuring 1.2 km × 0.63 km = 0.756 sq. km

The neighbors down the street from Ramona's family have decided to build a deck in their backyard also. Their deck will be 1.5 meters wide and 3.6 meters long.

- Estimate the area of this deck, and write your estimate in your journal.
- Make a labeled sketch of the deck. Then use your sketch to find its actual area.

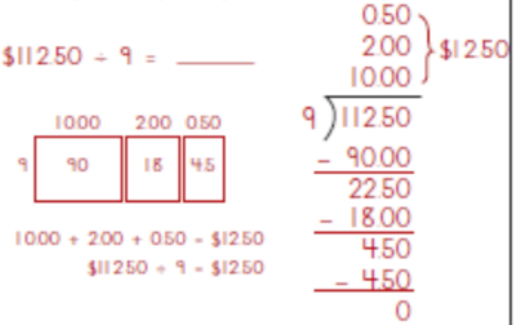


Use the partial products method and the standard multiplication algorithm to find the area of the neighbors' deck.

Partial Products	Standard Algorithm
3.6 × 1.5 1 × 3 = 3 1 × 0.6 = 0.6 0.5 × 3 = 1.5 0.5 × 0.6 = 0.30 5.40 sq m	3 3.6 × 1.5 1.80 3.60 5.40 sq m

- Solve problems with decimal division using arrays, ratio tables, partial products and quotients, and introduce long division notation.

Examples:

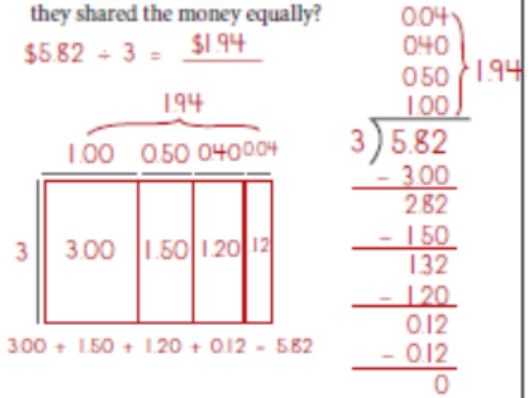


1 If school lunches cost $112.50 per quarter (9 weeks), about how much would each week of lunches cost?

$112.50 ÷ 9 = ______

Ratio Table for 9

Number of Groups	Total
1.00	9.00
2.00	18.00
10.00	90.00
20.00	180.00
0.50	4.50

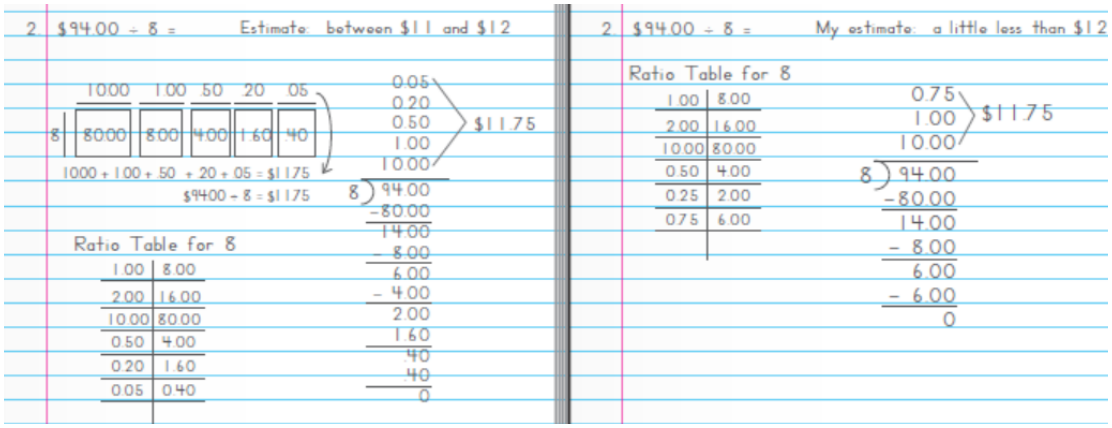


2 Alexander and his two brothers went to the zoo with their grandpa. At the end of the day, he gave the boys all of his change. He had $ 5.82 in his pocket. How much money did each brother get if they shared the money equally?

$5.82 ÷ 3 = $1.94

Ratio Table for 3

Number of Groups	Total
1.00	3.00
2.00	6.00
0.50	1.50
0.10	0.30
0.20	0.60
0.30	0.90
0.40	1.20
0.04	0.12



Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Checkpoints • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 1: Multi-Digit Whole Number and Decimal Operations
Pacing	Six weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.NS.2 Fluently divide multi-digit numbers using the standard algorithm.

6.NS.3 Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*

Students will be able to:	*Students will know/understand:*
• Find quotients using the standard algorithm to divide multi-digit whole numbers.	• Standard algorithm for long division
• Express the remainder as a fraction and a decimal.	• Standard algorithm for long division
• Understand the meaning of the remainder in the context of a real-world problem.	• Standard algorithm for long division
• Calculate sums, differences, products, and quotients using the standard algorithm to add, subtract, multiply, and divide multi-digit decimals.	• Standard algorithm for long division • Standard algorithm for addition, subtraction, multiplication, and division of decimals
• Solve multi-step problems using the standard algorithm to add, subtract, multiply, and divide multi-digit decimals.	• Standard algorithm for long division • Standard algorithm for addition, subtraction, multiplication, and division of decimals

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How can an algorithm be used to compute multi-digit decimals?	1. The standard algorithm can be applied to calculate sums, differences, products, and quotients to problems with and without context.
2. What is the purpose of computation with decimals?	2. Computation with decimal values can be applied to real world concepts such as money, measurement, evaluating expressions and solving equations.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

*Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can compute fluently without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Multiplication, Division, Decimals, Add and Subtract Decimals, Multiply and Divide Decimals, Mixed Operations, Money

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Sum- the result of adding two or more numbers.
- Difference- the result of subtracting two quantities.
- Factor- a number that is multiplied by another number to find a product.
- Product- the result of multiplying two or more factors.
- Divisor- a number by which another number is to be divided.
- Dividend- the quantity that is to be divided.
- Quotient- the result of dividing one quantity by another quantity.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Students learn to fluently divide multi-digit whole numbers using the standard algorithm. Students utilize their understanding of whole number place value to add, subtract, multiply, and divide decimals using the standard algorithm and to solve multi-step real world problems involving whole numbers and decimals. The fluency standards 6.NS.2 and 6.NS.3 should be reinforced throughout the rest of the grade six units of study. These standards will be integrated as students work with expressions and equations and solve problems about geometry and data.

Learning Tasks

Week One:

- Understand the concept of division.
- Find quotients using the standard algorithm to divide multi-digit whole numbers.

Week Two:

- Find quotients using the standard algorithm to divide multi-digit whole numbers.
- Express the remainder as a fraction and a decimal; understand the meaning of the remainder in the context of a real-world problem.

  *Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Week Three:

- Demonstrate understanding of decimal place value by naming, comparing, and plotting decimals on a number line.
- Calculate sums, differences, and products, and quotients using the standard algorithm to add, subtract, and multiply multi-digit decimals.
- Calculate products of decimals and powers of 10 using mental math.

Example:

➢ Determine whether the following statement is always, sometimes, or never true. Give examples to justify your answer.

The product of two decimals less than 1 is less than either of the factors.

Week Four:

- Round multi-digit whole numbers and decimals using previous understanding of place value.
- Calculate quotients using the standard algorithm to divide multi-digit decimals by whole numbers.

Week Five:

- Calculate quotients using the standard algorithm to divide multi-digit decimals by whole numbers and decimals.

Week Six:

- Solve multi-step problems using the standard algorithm to add, subtract, multiply, and divide multi-digit decimals.

Example:

➢ Collin needs three wooden boards to repair his porch. The lengths he needs are 2.2 meters, 2.82 meters, and 4.25 meters. He purchases a board that is 10 meters long and cuts the three sections. How much of the board that Collin purchased will be left?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

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☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

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Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 2: Fractions Operations; Division of Fractions; Factors and Multiples
Pacing	Five weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.NS.A.1 Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is ⅔. In general, (a/b) ÷ (c/d) = ad/bc.*

Supporting Standard:

6.NS.4 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4*(*9+2*).

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: ● Find the greatest common factor (GCF) and the least common multiple (LCM) for a pair of numbers.	*Students will know/understand:* ● Greatest Common Factor (GCF) ● Least Common Multiple (LCM)
● Solve real world problems involving GCF and LCM.	● Greatest Common Factor (GCF) ● Least Common Multiple (LCM)
● Use mathematical models and equations to represent the division of fractions.	● Models for division of fractions (area model, number line) ● Algorithm for division of fractions ● Numerator ● Denominator ● Divisor ● Dividend ● Quotient ● Reciprocal
● Find quotients to represent the division of fraction by fraction.	● Algorithm for division of fractions ● Numerator ● Denominator ● Divisor ● Dividend ● Quotient ● Reciprocal
● Understand the fraction division algorithm $a/b \div c/d = ad / bc$.	● Algorithm for division of fractions ● Numerator ● Denominator ● Divisor ● Dividend ● Quotient ● Reciprocal
● Apply the division algorithm to solve real world problems involving mixed numbers and improper fractions.	● Algorithm for division of fractions ● Divisor ● Dividend ● Quotient
● Explain the meaning of the remainder	● Models for division of fractions (area

in the context of a real-world problem.	model, number line) • Algorithm for division of fractions • Meaning of remainders

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is division of fractions useful?	1. The division of fractions is related to multiplication. Models explain why a quotient can be larger than the dividend and/or the divisor.
2. What is the purpose of the division of fractions?	2. The division of fractions can be applied to real-world problem solving involving equal sharing, measurement, and unknown factors.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

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Informational Texts

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- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Divide Fractions

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Greatest Common Factor (GCF)- the largest positive integer that divides evenly into all numbers in each set with zero remainder.
- Least Common Multiple (LCM)- the smallest common multiple for a given set of numbers.
- Divisor- a number by which another number is to be divided.
- Dividend- the quantity that is to be divided.
- Quotient- the result of dividing one quantity by another quantity.
- Numerator- the number in a fraction that represents the number of parts of a whole.
- Denominator- the number in a fraction that represents the number of equal parts of a whole.
- Reciprocal- a quantity that when multiplied by another number gives one

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students develop a conceptual understanding of dividing a fraction by a fraction using models and equations to solve real world problems. Students learn the relationship between fraction multiplication and fraction division and utilize the algorithm for division of fractions to solve problems. Standard 6.NS.4 (Factors and Multiples) is an *additional content standard*, but students should understand relationships among numbers and how to use factors and multiples to solve problems.

Learning Tasks

Week One:

- Understand rules of divisibility and apply to finding factors.
- Find the greatest common factor (GCF) for a pair of numbers; use various strategies including factor towers and prime factorization.
- Solve real world problems involving GCF.
- Apply understanding of GCF and divisibility rules to simplify fractions.

Examples:

➢ Lana earned $49 on Friday, $42 on Saturday, and $21 on Sunday selling bracelets. She sold each bracelet for the same amount. What is the most she could have charged for each bracelet?

➢ Michelle has two pieces of twine, one 15 feet long and the other 10 feet long. If she wants to cut them up to produce many pieces of twine that are all of the same length, with no twine left over, what is the greatest length, in feet, that she can make them?

Week Two:

- Find the least common multiple (LCM) for a pair of numbers.
- Solve real world problems involving LCM.
- Understand equivalence and convert fluently between mixed numbers and improper fractions.
- Add and subtract fractions and mixed numbers while applying understanding of GCF and LCM.

Examples:

➢ Ernesto has painting class every two weeks. Kamala has a pottery class every five weeks. Ernesto and Kamala met at the art building for class this week. How many weeks will it be until they see each other again?

➢ Akira and Kelly are training for a marathon. Akira runs 9 kilometers at a time while Kelly prefers to run in blocks of 6 kilometers. At the end of a month, they realize that they have run the same total number of kilometers. What is the smallest number of kilometers that each must have run?

Week Three:

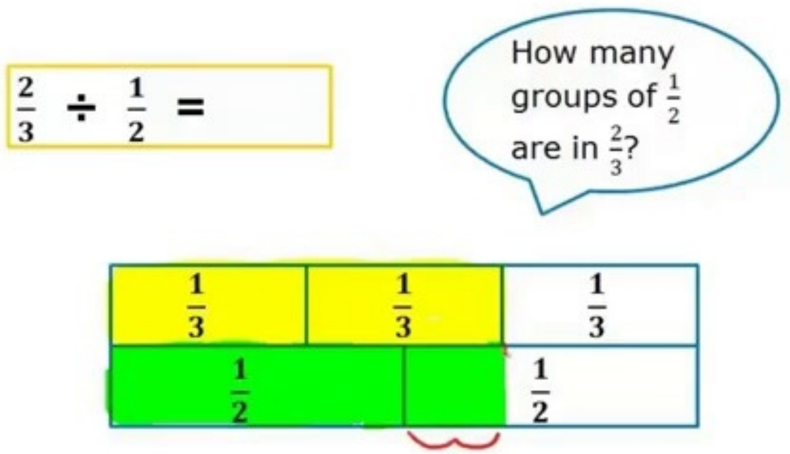
- Review previously learned algorithms for adding, subtracting, and multiplying fractions and mixed numbers.

*Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Week Four:

- Use mathematical models to represent the division of fractions.

  ➢ ***Bar Diagram:***



Answer: 1 ⅓

  ➢ [***Video: Find the Quotient Using an Area Model***]

- Understand the fraction division algorithm *a/b ÷ c/d = ad / bc;* find quotients to represent the division of fraction by fraction.

$$\frac{1}{4} \div \frac{3}{8} = \frac{1}{4} \bullet \frac{8}{3} = \frac{1}{\cancel{4}_{1}} \bullet \frac{\cancel{8}^{2}}{3} = \frac{2}{3}$$

- Calculate quotients of mixed numbers using the division algorithm.

Week Five:

- Apply the division algorithm to solve real world problems involving mixed numbers and improper fractions.

Examples:

  - ➢ How much chocolate will each person get if 3 people share 1/2 lb. of chocolate equally?
  - ➢ How many 3/4-cup servings are in 2/3 of a cup of yogurt?
  - ➢ How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?

- Explain the meaning of the remainder in the context of a real-world problem.

Example:

  - ➢ Vera is planting flowers. She puts ⅔ liters of potting soil in each pot. She has 2 ¾ liters of soil. How many pots can she fill completely? Show your work and explain your answer.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still

struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 3: Ratios and Rates
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

6.RP.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship including the use of units. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger." (Expectations for unit rates in this grade are limited to non-complex fractions.)*

6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.

b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?* c. Find a percent of a quantity as a rate per 100 (e.g. 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Understand the concepts of ratios, rate, and unit rate.	*Students will know/understand:* • Ratios • Ratio tables • Rate • Unit Rate • Unit Price
• Use ratio and rate language to describe the relationship between two quantities.	• Ratios • Ratio tables • Rate • Unit Rate • Unit Price • Proportional Relationships
• Solve unit rate problems including unit pricing and constant speed.	• Unit Rate • Unit Price • Proportional Relationships
• Graph data from a ratio table.	• Ratios • Ratio tables • Rate • Unit Rate • Proportional Relationships
• Analyze data in a ratio table or graph to determine proportionality.	• Ratio tables • Proportional Relationships
• Use ratio and rate reasoning to solve real world mathematical problems.	• Ratios • Rate • Unit Rate • Unit Price • Proportional Relationships

• Use multiplication and division to make tables of equivalent ratios and find missing values.	• Ratios • Ratio tables
• Use ratio and rate reasoning to convert measurement units.	• Ratios • Ratio tables • Rate • Unit Rate • Proportional Relationships
• Convert between units appropriately when multiplying or dividing quantities within a problem.	• Ratios • Ratio tables • Proportional Relationships

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are ratios useful?	1. Ratios can be applied to understand a comparison of number values and relationships involving proportionality.
2. What is the purpose of ratios and rates?	2. Ratios and rates can be applied to real-world problem-solving involving money, percents, unit pricing, measurement, and values of equivalence.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

*Calculator permitted minimally as an introduction to the online Desmos calculator; the objectives of the unit are centered around developing mathematically proficient students who can discern patterns and structure without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Ratios and Rates, Units of Measure
- Desmos 4 function calculator

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Ratio- a comparison of two values.
- Ratio Table- a model that represents equivalent ratios.
- Rate- a special ratio in which the two quantities being compared are measured by different units.
- Unit Rate- ratio describing how many units of one quantity relates to one unit of the second quantity.
- Unit Price- ratio that describes the cost of one unit of an item.
- Proportion- two equal ratios.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students understand and relate two quantities using ratios, rates, and unit rates. Students solve problems with ratios utilizing tables to show equivalence. Students apply their knowledge of ratios to solve problems and units of measure. Students build an understanding of proportional relationships.

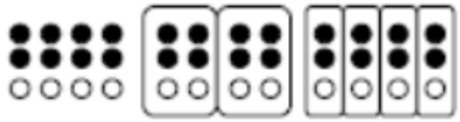
Learning Tasks

Week One:

- Understand the concepts of ratios, rate, and unit rate; use ratio and rate language to describe the relationship between two quantities.

➢ A ratio is a comparison of two quantities which can be written as *a* to *b*, or *a:b*.

➢ A comparison of 8 black circles to 4 white circles can be written as the ratio of 8:4 and can be regrouped into 4 black circles to 2 white circles (4:2) and 2 black circles to 1 white circle (2:1).



Students should be able to identify all these ratios and describe them using “For every…., there are …”

➢ Express the ratio of yellow to red counters in three ways; understand this is a *part-to-part ratio.*

2:3 *2 to 3* $\frac{2}{3}$

➢ Express *part to whole ratios*

The ratio of red counters to the total number of counters is:

3:5 *3 to 5* $\frac{3}{5}$

- Solve unit rate problems including unit pricing and constant speed.

➔ A unit rate compares a quantity in terms of one unit of another quantity. Students will often use unit rates to solve missing value problems. Cost per item or distance per time unit are common unit rates, however, students should be able to flexibly use unit rates to name the amount of either quantity in terms of the other quantity. Students will notice that related unit rates are reciprocals as in the first example. It is not intended that this be taught as an algorithm or rule because at this level, students should primarily use reasoning to find these unit rates. *In Grade 6, students are not expected to work with unit rates expressed as complex fractions. Both the numerator and denominator of the original ratio will be whole numbers.

Examples:

➢ Four potted plants cost $88. What is the price per plant?

➢ On a math test, it took Kiera 30 minutes to do 6 problems. Heath finished 18 problems in 40 minutes. Did the students work at the same rate? Show your work and explain your answer.

➢ A 12 oz box of Thanksgiving stuffing is $2.15, while a 16 oz box costs $2.88. Which is the better buy?

Week Two:

- Use multiplication and division to make tables of equivalent ratios and find missing values.

Example:

➢ Victoria reads at a constant rate of 10 pages every 16 minutes.

Part A: Use Victoria's reading rate to complete the table.

Number of Pages		25	35	
Time (min)	8			64

Part B: How many minutes will Victoria take to read 100 pages?

- Use ratio and rate reasoning to convert measurement units; convert between units appropriately when multiplying or dividing quantities within a problem.

Example:

➢ Using the information in the table, find the number of yards in 24 feet.

Feet	3	6	9	15	24
Yards	1	2	3	5	?

There are several strategies that students could use to determine the solution to this problem.

- ○ Add quantities from the table to total 24 feet (9 feet and 15 feet); therefore, the number of yards must be 8 yards (3 yards and 5 yards).
- ○ Use multiplication to find 24 feet: 3 feet x 8 = 24 feet; therefore 1 yard x 8 = 8 yards, or 6 feet x 4 = 24 feet; therefore 2 yards x 4 = 8 yards.

- Use ratio and rate reasoning to solve real world mathematical problems.

Examples:

➢ There are 18 bulls and 45 cows on a ranch. If 4 more bulls and 4 more cows were added, will the ratio of bulls to cows remain the same? Justify your answer using a ratio table.

➢ If 45 cookies will serve 15 students, how many cookies are needed for 30 students?

➢ Four students spent $12 on school lunch. At this rate, find the amount 10 students would spend on the same school lunch.

Week Three:

- Review graphing in quadrant 1 on the coordinate plane.

- Graph data from a ratio table; analyze data in a ratio table or graph to determine proportionality.

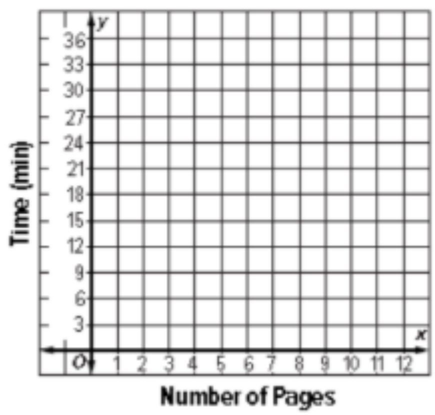
Example:

➢ Desta reads at a constant rate of 3 pages every 8 minutes.

Part A: Complete the ratio table for Desta's reading rate.

Number of Pages	3	6		12
Time (min)	8		24	

Part B: Graph the ordered pairs that show the time it takes Desta to read 3, 6, 9, and 12 pages.



Week Four:

- Understand a proportion as two equivalent ratios.
- Solve real world problems by writing and solving proportions.
- Convert between units of measure using proportions.
- Convert between units using dimensional analysis; understand ratios equivalent to one.

Examples:

➢ Kristen's birthday party will cost $5.40 if she invites 3 guests. If there are 7 guests, how much will Kristen's birthday party cost?

➢ Elise ran a total of 6.9 miles over the course of 3 track practices. How many miles would Elise have run after 5 track practices?

➢ Luis drew a scale drawing of the elementary school. The scale he used was 1 centimeter: 8 meters. The actual length of the schoolyard is 112 meters. How long is the schoolyard in the drawing?

- ➢ Kamal earned a total of $2.16 by selling 6 cups of lemonade. After selling a total of 8 cups of lemonade, how much money will Kamal have made in all?
- ➢ A baby elephant weighs 260 pounds. How many ounces does the baby elephant weigh?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

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Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

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Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Entrance/Exit Slips

• Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 4: Understanding and Modeling Rational Numbers
Pacing	Two weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.NS.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.

6.NS.6 Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.

- Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite.
- Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.
- Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

6.NS.7 Understand ordering and absolute value of rational numbers.

- Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.*
- Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –$3 > –$ 7 to express the fact that –$3 is more than – $7.*
- Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of -30 dollars, write /-30/ = 30 to describe the size of the debt in dollars.*
- Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than – 30 dollars represents a debt greater than 30 dollars.*

6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*

Students will be able to:	*Students will know/understand:*
• Understand rational numbers as points on a number line.	• Integers • Rational Numbers • Numbers Lines • Inequalities
• Find/plot points on a number line.	• Integers • Rational Numbers • Numbers Lines
• Recognize opposites.	• Integers • Opposites
• Understand absolute value as distance away from zero on a number line.	• Numbers Lines • Absolute Value
• Interpret relative position on a number line.	• Integers • Rational Numbers • Numbers Lines • Inequalities
• Order rational numbers.	• Integers • Rational Numbers • Numbers Lines
• Write and explain statements of order in a real-world context.	• Integers • Rational Numbers • Numbers Lines
• Understand ordered pairs as locations in a coordinate plane.	• The Coordinate Plane
• Find/plot points on the coordinate plane.	• Integers • Rational Numbers • Numbers Lines • The Coordinate Plane
• Determine vertical/horizontal distance between points in the coordinate plane.	• Numbers Lines • The Coordinate Plane • Absolute Value
• Plot reflection of points on the coordinate plane and recognize differences in the ordered pairs based on location.	• Numbers Lines • The Coordinate Plane • Absolute Value

• Solve real world problems involving number lines and the coordinate plane.	• Integers • Rational Numbers • Numbers Lines • The Coordinate Plane

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How can rational number values be represented?	1. Rational number values can be represented and compared on a number line.
2. What is the relationship between a number and its opposite?	2. Numbers and their opposites have the same absolute value, or distance away from zero on a number line.
3. How is the coordinate plane useful?	3. Coordinates are used to describe the location of a point.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. *Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can discern patterns and structure without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

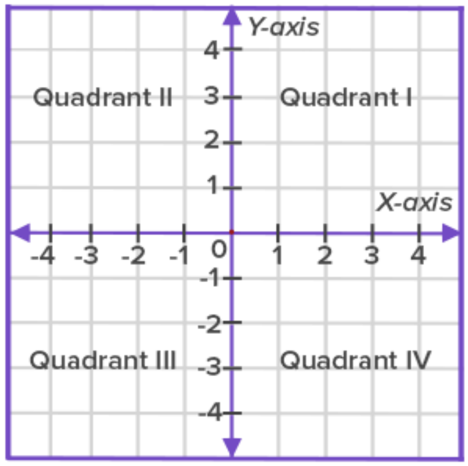
Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Integers, Rational Numbers, The Coordinate Plane

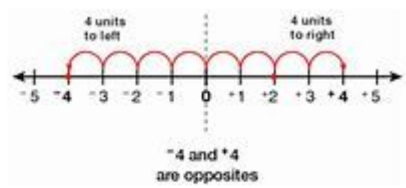
Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Integers- the set of whole numbers and their opposites.
- Rational Number- a number that can be expressed as an integer or the quotient of an integer divided by a nonzero integer.
- Number Line- line on which there is indicated a one-to-one correspondence between points on the line and the set of real numbers.
- Coordinate Plane- a two-dimensional plane formed by the intersection of a vertical line called the y-axis and a horizontal line called the x-axis. These are perpendicular lines that intersect each other at zero, and this point is called the *origin*. The axes cut the coordinate plane into four equal sections, and each section is known as a *quadrant.*



- Opposites- two numbers that are the same distance, but in opposite directions, from zero on a number line.



- Absolute Value- the distance of a number from zero, regardless of direction; the distance is always positive, as the absolute value of a number cannot be negative.

- Inequality- A mathematical sentence that compares two unequal expressions using one of the symbols <, >, ≤, ≥, or ≠.

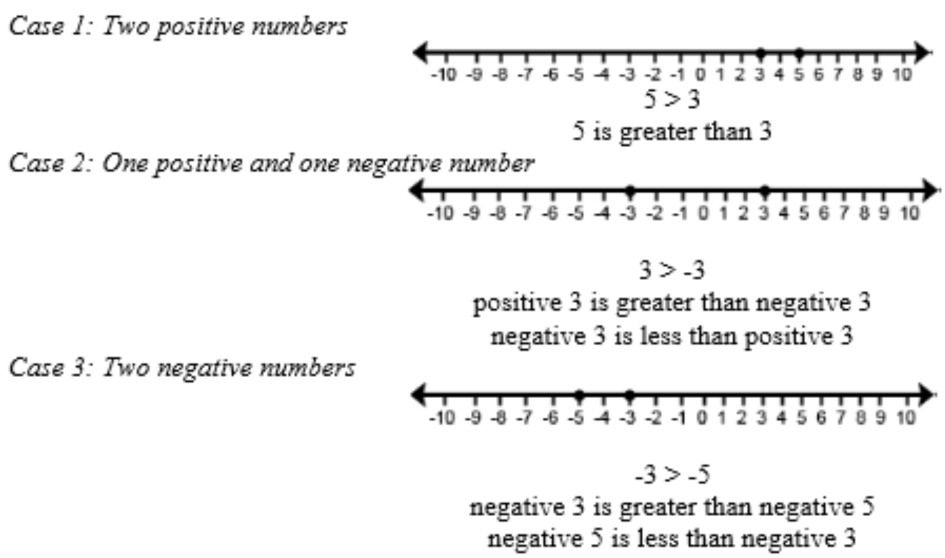
Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *major content cluster*. Students plot points on a number line and ordered pairs on the coordinate plane. Students use inequality symbols to compare rational numbers (integers, positive and negative fractions, and decimals) and develop an understanding that absolute value is a number's distance from zero on the number line. They solve real-world problems by graphing points in all four quadrants and find distance between points that have the same x or y coordinate.

Learning Tasks

Week One:

- Understand rational numbers as points on a number line; find/plot points on a number line; interpret relative position on a number line; order rational numbers; write statements of order in a real-world context.

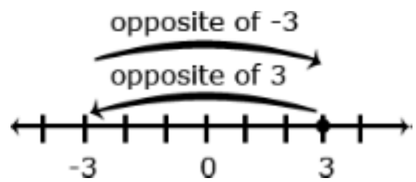
    ➔ In working with number line models, students internalize the order of the numbers, larger numbers on the right or top of the number line and smaller numbers to the left or bottom of the number line. They use the order to correctly locate integers and other rational numbers on the number line. By placing two numbers on the same number line, they can write inequalities and make statements about the relationships between the numbers.



*Comparative statements generate informal experience with operations and lay the foundation for formal work with operations on integers in grade 7.

- Recognize opposites; understand absolute value as distance away from zero on a number line.

    ➔ Number lines can be used to show numbers and their opposites. Both 3 and -3 are 3 units from zero on the number line. Graphing points and reflecting across zero on a number line extends to graphing and reflecting points across axes on a coordinate grid. The use of both horizontal and vertical number line models facilitates the movement from number lines to coordinate grids.



*Students recognize the distance from zero as the absolute value or magnitude of a rational number. Students need multiple experiences to understand the relationships between numbers, their opposites, absolute value, and statements about order.

Week Two:

- Understand ordered pairs as locations in a coordinate plane.

- Find/plot points in the coordinate plane.

- Determine vertical/horizontal distance between points in the coordinate plane.

- Determine location of reflected point across each axis.

Example:

➢ Graph the following points in the correct quadrant of the coordinate plane. If you reflected each point across the x-axis, what are the coordinates of the reflected points? What similarities do you notice between coordinates of the original point and the reflected point?

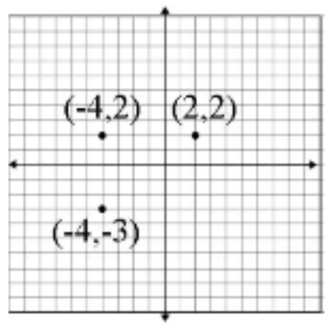
(0.25, -0.75) (-½, -3) (½, -3½)

- Solve real world problems involving number lines and the coordinate plane.

Examples:

- ➢ On a coordinate plane, draw triangle ABC with vertices A (-1, -1), B (3, -1), and C (-1, 2). Find the area of the triangle in square units.

- ➢ If the points on the coordinate plane below are the three vertices of a rectangle, what are the coordinates of the fourth vertex? How do you know? What are the length and width of the rectangle?



Westbrook Public Schools' Portrait of a Graduate **Learning Expectations**
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Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

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Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

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Include an overview of authentic assessments

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- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 5: Percent
Pacing	Four weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices: *(Practices in bold are to be emphasized in the unit.)* **1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** 3. Construct viable arguments and critique the reasoning of others. **4. Model with mathematics.** 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. **8. Look for and express regularity in repeated reasoning.** ***Priority/Focus Standards:*** 6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or

equations. a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?* c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. d. Use ratio reasoning to convert measurement units; manipulate and transform units. appropriately when multiplying or dividing quantities.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Understand equivalence and convert fluently between fractions, decimal, and percent.	*Students will know/understand:* • Ratios • Rational Number Equivalence • Proportional Relationships
• Use a variety of strategies such as tape diagrams, proportions, or equations to calculate a percent of a quantity as a rate per 100.	• Ratios • Percent • Proportional Relationships
• Solve problems to calculate the whole given a part and the percent.	• Percent • Proportional Relationships

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are percents useful?	1. Knowledge and applications of percents can be applied to understand a comparison of number values and relationships involving proportionality.
2. How are percentages used to solve problems?	2. Percents are often used in real-life situations involving money such as discount, sale price, tax, and tip.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. *Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can discern patterns and structure without the use of technology.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)

- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: MathAntics.com

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Percents, Percents of Number, Fractions, and Decimals

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Ratio- a comparison of two values.
- Rate- a special ratio in which the two quantities being compared are measured by different units.
- Percent- parts per 100.
- Proportion- two equal ratios.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students understand equivalence and compare rational numbers written as fractions, decimals, and percents. Students apply their knowledge of ratios to solve problems involving percents. Students build on their understanding of proportional relationships to solve real world percent problems.

Learning Tasks

Week One:

- Relate fractions, decimals and percents.

    ➢ *Benchmark Conversions: Fractions, Decimals and Percents*

Fraction	Decimal	Percent
$^1/_{10}$	0.1	10%
$^2/_{10} = {}^1/_5$	0.2	20%
$^1/_4$	0.25	25%
$^3/_{10}$	0.3	30%
$^1/_3$	$0.\bar{3}$	$33.\bar{3}\%$
$^4/_{10} = {}^2/_5$	0.4	40%
$^5/_{10} = {}^1/_2$	0.5	50%
$^6/_{10} = {}^3/_5$	0.6	60%
$^2/_3$	$0.\bar{6}$	$66.\bar{6}\%$
$^7/_{10}$	0.7	70%
$^3/_4$	0.75	75%
$^8/_{10} = {}^4/_5$	0.8	80%
$^9/_{10}$	0.9	90%
$^{10}/_{10} = 1$	1.0	100%

Fraction to Decimal

•To convert a fraction to a decimal - divide the numerator by the denominator. (top in, bottom out)

$\frac{1}{4} \rightarrow 4\overline{)1} \rightarrow .25$

$\frac{3}{7} \rightarrow 7\overline{)3} \rightarrow .428$

Decimal to Fraction

•To convert a decimal to a fraction - write it like you say it, then simplify, if needed.

.7 → "seven tenths" → $\frac{7}{10}$

4.28 → "four and twenty eight hundredths" → $4\frac{28}{100} = 4\frac{7}{25}$

Decimal to Percent

•To convert a decimal to a percent - move the decimal point two places to the RIGHT and add a percent sign.

2.36 -> 2.36 -> 236%　　　0.03 -> 0.03 -> 3%

Percent to Decimal

•To convert a percent to a decimal - move decimal point two places to the LEFT and remove the percent sign.

32% -> 32% -> 0.32　　　100% -> 100% -> 1.00

Percent to Fraction

•To convert a percent to a fraction - first convert to a decimal, and then convert the decimal to a fraction.

Percent to Decimal　　　Decimal to Fraction

32% -> 32% -> 0.32 -> " thirty two hunderdthes" -> $\frac{32}{100}$

Fraction to Percent

•To convert a fraction to a percent - first convert to a decimal, then convert the decimal to percent.

Fraction to Decimal

$\frac{3}{8}$ → Divide numerator by denominator → $8\overline{)3}$ → 0.375 → 0.375 → 37.5%

Week Two:

- Solve percent problems to find the part of the whole using tape/bar diagrams.
  - ➢ What is 40% of 250?

100%

250									
25	25	25	25	25	25	25	25	25	25
10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Solution: 100

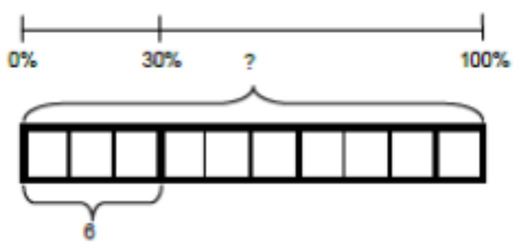
- Solve percent problems to find the part of the whole using proportion and expression.

Week Three:

- Calculate percent given the part and the whole.
- Solve problems to calculate the whole given a part and the percent given the part and the whole; use a variety of strategies such as tape diagrams, proportions, or equations.

Examples:

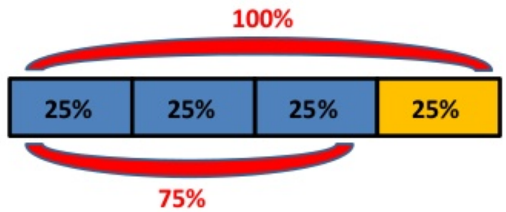
➢ If 6 is 30% of a value, what is that value?



Solution: 20

➢ ***Challenge:*** If the sale price of a TV after a 25% discount is $600, find the original price of the TV.

First we show what would be 100% in 4 parts because of the 25%



The 75% represents $600 and is shown to be 3 of the parts.
So $600 ÷ 3 = $200. That means each section (25%) represents $200
Which means your discount was $200 and that added onto
the $600 makes the original price of the television $800.

Week Four:

- Solve real world problems involving percents.

Examples:

- ➢ In one day at a store, 7% of the sales were from shoes. Write 7% as a decimal.
- ➢ In a recent year, 0.57 of those registered to vote in the United States voted in an election. Write 0.57 as a percent.
- ➢ During his workout, Elan spent 28% of the time on the treadmill. What fraction of his workout did he spend on the treadmill?
- ➢ The original price of a pair of shoes is $42. The sale price is 20% off the original price. What is the discount (amount off) the original price? What is the sale price?
- ➢ Your bill for lunch comes to $44.75. You and your two friends split the bill equally. How much do you each owe? Don't forget to add in a 20% tip first.
- ➢ After shopping for groceries, your subtotal is $50.50. If you must pay a 6% sales tax, what is the total cost of your groceries?
- ➢ A credit card company charges 17% interest on any charges not paid at the end of the month. Make a ratio table to show how much the interest would be for several amounts. If your bill totals $450 for this month, how much interest would you have to pay if you let the balance carry to the next month? Show the relationship on a graph and use the graph to predict the interest charges for a $300 balance.

Charges	$1	$50	$100	$200	$450
Interest	$0.17	$8.50	$17	$34	?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 6: Identify, Write and Evaluate Expressions; Equivalent Expressions
Pacing	Four weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.EE.1 Write and evaluate numerical expressions involving whole-number exponents.

6.EE.2 Write, read, and evaluate expressions in which letters stand for numbers.

- Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.*

- Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2(8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.*
- Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of lengths = 1/2.*

6.EE.3 Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6(4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.*

6.EE.4 Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number replaces the variable y.*

6. EE.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*

Students will be able to:	*Students will know/understand:*
• Model expressions with algebra tiles	• Term • Coefficient • Constant • Variable • Expression • Equivalent expressions
• Write expressions	• Coefficient • Constant • Variable • Expression • Equivalent expressions
• Read expressions	• Term • Coefficient • Constant • Variable • Expression

• Evaluate expressions	• Term
	• Coefficient
	• Constant
	• Variable
	• Expression
	• Equivalent expressions
	• Order of Operations
	• Properties of operations:
	    ○ Commutative
	    ○ Associative
	    ○ Distributive
	    ○ Identity

• Identify terms	• Term • Coefficient • Constant • Variable
• Perform the Order of Operations	• Equivalent expressions • Order of Operations
• Apply properties of operations	• Order of Operations • Properties of operations: ○ Commutative

	○ Associative ○ Distributive ○ Identity
● Generate equivalent expressions	● Equivalent expressions ● Order of Operations ● Properties of operations: ○ Commutative ○ Associative ○ Distributive ○ Identity

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. Why is it important to have an Order of Operations in math?	1. It is important to have a set of rules for simplifying expressions.
2. How are equivalent expressions identified?	2. Equivalent expressions have the same value when evaluated for the same variable.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

*Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can discern the patterns and structure of algebraic expressions without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Expressions and Properties

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Term- a single number or variable, or the product of numbers and variables
- Coefficient- numerical or constant quantity multiplied by a variable.
- Constant- a number whose value remains unchanged.
- Variable- a value that may change within the scope of a given problem or set of operations; usually represented by a lowercase letter.
- Expression- a mathematical phrase that combines numbers and/or variables using mathematical operations, a representation of a value.
- Equivalent expressions- expressions that simplify to equivalent values when the same numbers are substituted for the variables in the expression.

- Order of Operations- rules about which procedures to perform first to evaluate a given mathematical expression.

- Commutative Property- a property which states that the order in which an operation is performed does not matter; addition and multiplication are commutative operations ($a+b=b+a$ *and* $ab=ba$), but subtraction and division are not

- Associative Property- a property which states that when three or more values are added or multiplied, the sum or the product is the same regardless of the grouping of the addends or the factors; $(a+b)+c=a+(b+c)$ and $(ab)c=a(bc)$

- Distributive Property- a property which states that multiplying the sum of two or more addends by a number will give the same result as multiplying each addend individually by the number and then adding the products together; $a(b+c)=ab+ac$

- Identity Property of Addition- any number plus zero is the original number.

- Identity Property of Multiplication- any number times one is the original number.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students begin to incorporate whole number exponents into numerical expressions and to translate words to algebraic expressions. They evaluate variable expressions and formulas that have whole number exponents and that incorporate order of operations. They learn to manipulate algebraic expressions and produce different but equivalent expressions. The focus of 6.NS.4 is the use of the distributive property. Appropriate vocabulary is emphasized throughout the unit. Later in the year, students will continue to use their knowledge of expressions in their work with equations and geometry.

Learning Tasks

Weeks One:

- Evaluate numerical expressions involving powers and exponents.

Examples:

➢ Write the following as numerical expressions using exponential notation:

  - The area of a square with a side length of 8 m
  - The volume of a cube with a side length of 5 ft
  - Yu-Lee has a pair of mice. The mice have 2 babies. The babies grow up and have two babies of their own

- Evaluate expressions by applying the Order of Operations and properties of operations.

Examples:

➢ *Evaluate:*

  o 4^3

  o $5 + 2^4 \bullet 6$

  o $7^2 - 24 \div 3 + 25$

Week Two:

- Model expressions with algebra tiles; identify terms; write expressions; read expressions.

➔ Students use their understanding of multiplication to interpret *3(2+x)*. *For example, 3 groups of (2 + x)*. They use a model to represent x and make an array to show the meaning of *3(2+x)*. They can explain why it makes sense that *3(2+x)* is equal to *6+3x*.

An array with 3 columns and x + 2 in each column:

■ ■ ■

■ ■ ■

I I I

Students interpret *y* as referring to one *y*. Thus, they can reason that one *y* plus one *y* plus one *y* must be *3y*. They also use the distributive property, the multiplicative identity property of 1, and the commutative property for multiplication to prove that $y + y + y = 3y$:

$$y + y + y = y(1) + y(1) + y(1) = y(1 + 1 + 1) = y(3) = 3y$$

➢ It is important for students to read algebraic expressions in a manner that reinforces that the variable represents a number:

- r + 21 as "some number plus 21 as well as "r plus 21"
- n • 6 as "some number times 6 as well as "n times 6"
- s ÷ 6 as "as some number divided by 6" as well as "s divided by 6"

Vocabulary:

Students should identify the parts of an algebraic expression including variables, coefficients, constants, and the names of operations (sum, difference, product, and quotient). Development of this common language helps students to understand the structure of expressions and explain their process for simplifying expressions.

Terms are the parts of a sum. When the term is an explicit number, it is called a constant. When the term is a product of a number and a variable, the number is called the coefficient of the variable.

Variables are letters that represent number values. There are various possibilities for the number they can represent. Students can substitute these possible numbers for the letters in the expression for various purposes.

Consider the following expression: $x^2 + 5y + 3x + 6$:

- The variables are x and y.
- There are 4 terms, x^2, 5y, 3x, and 6.
- There are 3 variable terms, x^2, 5y, 3x. They have coefficients of 1, 5, and 3 respectively.
- The coefficient of x^2 is 1, since $x^2 = 1x^2$. The term 5y represent 5 y's or 5 ● y.
- There is one constant term, 6.
- The expression shows a sum of all four terms.

Examples:

- ○ 7 more than 3 times a number
- ○ 3 times the sum of a number and 5
- ○ 7 less than the product of 2 and a number
- ○ Twice the difference between a number and 5

- Evaluate $5(n + 3) - 7n$, when $n = 2$

- Evaluate algebraic expressions by applying the Order of Operations and properties of operations.

Example:

➢ What is the value of $2x + 7$ for the given values of x?
   a) x = 2
   b) x = 0
   c) x = 5

Week Three:

- Generate equivalent expressions.

➔ Students connect their experiences with finding and identifying equivalent forms of whole numbers and can write expressions in various forms. Students generate equivalent expressions using the associative, commutative, and distributive properties. They can prove that the expressions are equivalent by simplifying each expression into the same form.

Example:

➢ Are the expressions equivalent? How do you know?

$4m + 8$ $\qquad$ $4(m+2)$ $\qquad$ $3m + 8 + m$ $\qquad$ $2 + 2m + m + 6 + m$

Expression	Simplifying the Expression	Explanation
$4m + 8$	$4m + 8$	Already in simplest form
$4(m + 2)$	$4(m + 2)$ $4m + 8$	Distributive Property
$3m + 8 + m$	$3m + 8 + m$ $3m + m + 8$ $4m + 8$	Combined like terms
$2 + 2m + m + 6 + m$	$2 + 2m + m + 6 + m$ $2 + 6 + 2m + m + m$ $(2 + 6) + (2m + m + m)$ $8 + 4m$ $4m + 8$	Combined like terms

**Students may also substitute the same value for m in each expression to check if their values are equal.*

- Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number.

Examples:

- ➢ Maria has three more than twice as many crayons as Elizabeth. Write an algebraic expression to represent the number of crayons that Maria has.
- ➢ An amusement park charges \$28 to enter and \$0.35 per ticket. Write an algebraic expression to represent the total amount spent.
- ➢ Bill earned \$5.00 mowing the lawn on Saturday. He earned more money on Sunday. Write an algebraic expression that shows the amount of money Bill has earned.
- ➢ The expression c + 0.07c can be used to find the total cost of an item with 7% sales tax, where c is the pre-tax cost of the item. Use the expression to find the total cost of an item that cost \$25.
- ➢ The perimeter of a parallelogram is found using the formula $p = 2l + 2w$. What is the perimeter of a rectangular picture frame with dimensions of 8.5 inches by 11 inches?

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 7: Write and Solve Equations and Inequalities
Pacing	Four weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.EE.5 Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

6.EE.7 Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers. 6.EE.8 Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions. 6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.*

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Model one-step equations with algebra tiles	*Students will know/understand:* • Equation
• Solve one-step equations	• Equation
• Solve real-world and mathematical problems	• Equation
• Solve problems by writing and solving equations of the form x + p = q and px = q (p, q and x ≥ 0)	• Equation
• Write equations	• Equation

• Write one-step inequalities	• Inequality
• Identify and represent dependent and independent variables	• Dependent variable • Independent variable • Graph • Table
• Analyze relationships	• Equation • Dependent variable • Independent variable • Graph • Table • Inequality
• Use graphs and tables	• Dependent variable • Independent variable • Graph • Table

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. Why are properties of equality important?	1. Applying properties of equality ensures that the expressions on both sides of an equation remain equivalent.
2. When is a number a solution to an equation?	2. A number is a solution if it can be substituted for the variable to make the equation true.
3. How are equations, tables, and graphs related?	3. Equations, tables, and graphs can be used to represent the relationship between two variables.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. *Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can discern patterns and structure and solve one-step algebra equations without the use of technology.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems) • Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions) ***Media:*** N/A ***Online Resources/Websites:*** • IXL Lessons- Grade 6 Mathematics, One-Variable Equations, One-Variable Inequalities

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: • Equation- a mathematical statement that two expressions have equal value.

- Independent variable- a variable that is not influenced by another variable; the independent variable's value determines the value of the dependent variable. Independent variables represent the "input" value of a function, and are commonly denoted as "x."

- Dependent variable- a variable whose value depends upon independent variable(s); the dependent variable is what is being measured in an experiment or evaluated in a mathematical equation; the dependent variable is sometimes called the "output" and commonly denoted as "y."

- Inequality- a mathematical sentence that compares two unequal expressions using one of the symbols $<$, $>$, $\leq$, $\geq$, or $\neq$.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students draw on previous learning to determine which operations to use when writing equations. They study equations and inequalities and develop methods for solving them. Students understand that solving equations involves a process of reasoning to find the number(s) that make an equation true.

Learning Tasks

Week One:

- Reason solutions to one-step equations

➔ Beginning experiences in solving equations should require students to understand the meaning of the equation as well as the question being asked. Solving equations using reasoning and prior knowledge should be required of students to allow them to develop effective strategies such as using reasoning, fact families, and inverse operations. Students may use balance models in representing and solving equations and inequalities. Consider the following situation: *Joey had 26 papers on his desk. His teacher gave him some more and now he has 100. How many papers did his teacher give him?* This situation can be represented by the equation $26 + n = 100$ where n is the number of papers the teacher gives to Joey. This equation can be stated as "some number was added to 26 and the result was 100." Students ask themselves "What number was added to 26 to get 100?" to help them determine the value of the variable that makes the equation true. Students could use several different strategies to find a solution to the problem.

- Reasoning: 26 + 70 is 96. 96 + 4 is 100, so the number added to 26 to get 100 is 74.

- Use fact families to write related equations: $n + 26 = 100$, $100 - n = 26$, $100 - 26 = n$.

- Select the equation that helps you find n easily.

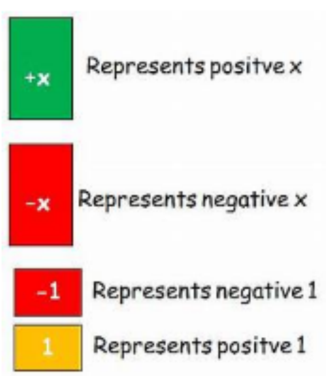
- Use knowledge of inverse operations: Since subtraction "undoes" addition then subtract 26 from 100 to get the numerical value of n.

- <u>Scale model</u>: There are 26 blocks on the left side of the scale and 100 blocks on the right side of the scale. All the blocks are the same size. 74 blocks need to be added to the left side of the scale to make the scale balance.

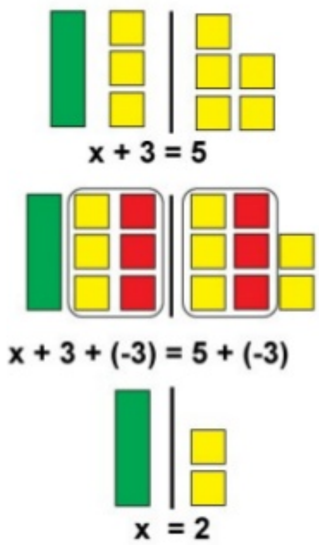
- <u>Bar Model</u>: Each bar represents one of the values. Students use this visual representation to demonstrate that 26 and the unknown value together make 100.

100	
26	***n***

- Model one-step equations with algebra tiles.



  - ***Example:*** Solve: $x+3=5$



*In this example a one-step equation of the form x+a=b is solved. Zero pairs are used in order to isolate the variable.

Week Two:

- Solve one-step equations using properties of equality; solve real-world and mathematical problems

Addition Property of Equality:

Example		
Problem	**Solve $x - 6 = 8$.**	
	$x - 6 = 8$	This equation means that if you begin with some unknown number, *x*, and subtract 6, you will end up with 8. You are trying to figure out the value of the variable *x*.
	$\begin{array}{r} x - 6 = 8 \\ \underline{+6} \quad \underline{+6} \\ x + 0 = 14 \end{array}$	Using the Addition Property of Equality, add 6 to both sides of the equation to isolate the variable. You choose to add 6, as 6 is being subtracted from the variable.
Answer	$x = 14$	

Subtraction Property of Equality:

Example		
Problem	**Solve $x + 7 = 42$.**	
	$x+7 = 42$	Since 7 is being added to the variable, subtract 7 to isolate the variable.
	$$\begin{array}{rcr} x+7 & = & 42 \\ \underline{-7} & & \underline{-7} \\ x+0 & = & 35 \end{array}$$	To keep the equation balanced, subtract 7 from both sides of the equation.
Answer	$x = 35$	

Multiplication Property of Equality:

Example		
Problem	**Solve $\frac{1}{2}x = 8$. Check your solution.**	
	$\frac{1}{2}x = 8$	The coefficient of $\frac{1}{2}x$ is $\frac{1}{2}$. Since the
	$2\left(\frac{1}{2}x\right) = 2(8)$	multiplicative inverse of $\frac{1}{2}$ is 2, you can multiply both sides of the equation by 2 to get a coefficient of 1 for the variable.
	$\frac{2}{2}x = 16$ $x = 16$	Multiply.
Check	$\frac{1}{2}(16) = 8$	Check by substituting your solution into the original equation.
	$\frac{16}{2} = 8$ $8 = 8$	The solution is correct!
Answer	$x = 16$	

Division Property of Equality:

Example		
Problem	**Solve $3x = 24$. Check your solution.**	
	$3x = 24$	Divide both sides of the equation by 3 to isolate the variable (have a coefficient of 1).
	$\frac{3x}{3} = \frac{24}{3}$ $x = 8$	Dividing by 3 is the same as having multiplied by $\frac{1}{3}$.
Check	$3x = 24$ $3 \bullet 8 = 24$ $24 = 24$	Check by substituting your solution, 8, for the variable in the original equation. The solution is correct!
Answer		$x = 8$

Week Three:

- Identify and represent dependent and independent variables; use graphs and tables to analyze relationships.

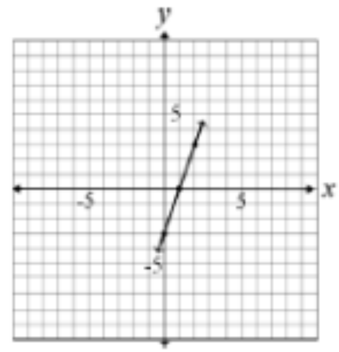
➔ Students can use many forms to represent relationships between quantities. Multiple representations include describing the relationship using language, a table, an equation, or a graph. Translating between multiple representations helps students understand that each form represents the same relationship and provides a different perspective on the function.

Examples:

➢ What is the relationship between the two variables? Write an equation that illustrates the relationship.

x	1	2	3	4
y	2.5	5	7.5	10

➢ Use the graph below to describe the change in y as x increases by 1.

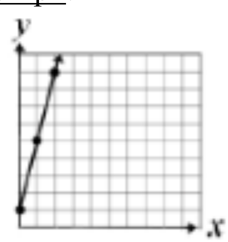


➢ Susan started with $1 in her savings. She plans to add $4 per week to her savings. Use an equation, table and graph to demonstrate the relationship between the number of weeks that pass and the amount in her savings account.

- <u>Language</u>: Susan has $1 in her savings account. She is going to save $4 each week.
- <u>Equation</u>: $y = 4x + 1$
- <u>Table</u>:

x	y
0	1
1	5
2	9

- <u>Graph</u>:



Week Four:

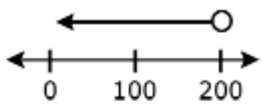
- Write one-step inequalities; represent solutions of such inequalities on number line diagrams *(as enrichment).*

Examples:

➢ *Graph $x \leq 2$.*

➢ *Jonas spent more than $50 at an amusement park. Write an inequality to represent the amount of money Jonas spent. What are some possible amounts of money Jonas could have spent?*

➢ *Less than $200.00 was spent by the Flores family on groceries last month. Write an inequality to represent this amount and graph this inequality on a number line.*



Westbrook Public Schools' Portrait of a Graduate **Learning Expectations**
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary/Real World/Global Connections
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 8: Area of Polygons and Surface Area
Pacing	Three weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.G.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate; apply these techniques in the context of solving real-world and mathematical problems. 6.G.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures; apply these techniques in the context of solving real-world and mathematical problems.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: ● Calculate the area of polygons	*Students will know/understand:* ● Area formulas for triangles and special quadrilaterals (rectangles, parallelogram, trapezoid) ● Square units
● Compose polygons into rectangles	● Area formula for rectangles ● Square units
● Decompose polygons into triangles and other special quadrilaterals	● Area formulas for triangles and special quadrilaterals (rectangles, parallelogram, trapezoid) ● Square units
● Draw polygons in the coordinate plane given coordinates for the vertices	● Coordinate plane ● Ordered pairs
● Find side lengths of polygons in the coordinate plane	● Distance on coordinate plane
● Calculate the surface area of three-dimensional figures using nets	● Area formulas for triangles and special quadrilaterals (rectangles, parallelogram,

	trapezoid) ● Square units ● Surface area ● Nets
● Solve real-world mathematical problems	● Area formulas for triangles and special quadrilaterals (rectangles, parallelogram, trapezoid) ● Square units ● Surface area ● Nets

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is the area of a polygon calculated?	1. The area of a polygon can be found by decomposing the figure into rectangles, triangles, and other special quadrilaterals with known area formulas.
2. How is the surface area of a three-dimensional figure found?	2. A net of rectangles and triangles can be used to find the surface area of a three-dimensional figure.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media:

- http://illuminations.nctm.org/ActivityDetail.aspx?ID=125
- http://illuminations.nctm.org/ActivityDetail.aspx?ID=205

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Geometric Measure
- Desmos 4 Function Calculator

Vocabulary/Terminology

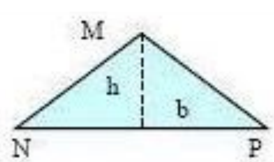
Vocabulary/Terminology with Definitions:

- Surface Area- the measure of the total area of surfaces of a three-dimensional figure

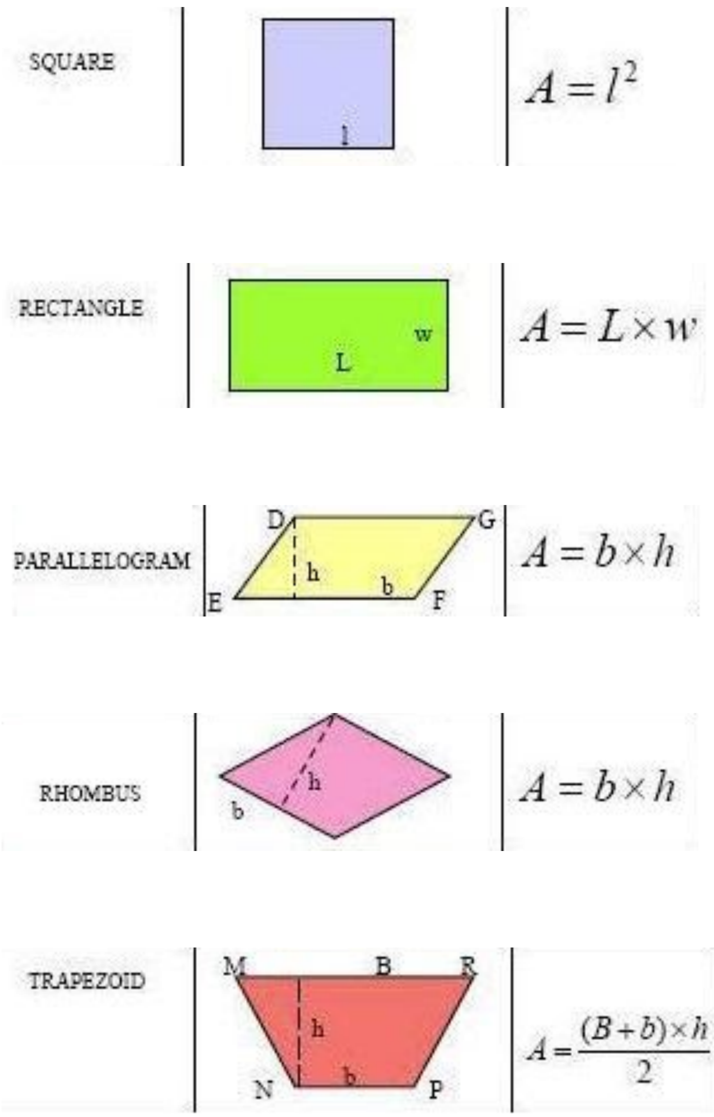
- Net- a two-dimensional representation (pattern) of a three-dimensional figure that can be folded to form the figure; in other words, a net is a "flattened" three-dimensional figure which can be turned into the solid by folding it

- Area Formulas-

TRIANGLE



$$A = \frac{b \times h}{2}$$



Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *supporting content cluster*. Students compose and decompose figures to relate areas to rectangles. They apply these techniques to solve real-world and mathematical problems. Students use the coordinate plane to find side lengths using the vertices of a figure. They represent three-dimensional figures using nets made up of rectangles and triangles. Students use the nets to find the surface area of these figures.

Learning Tasks

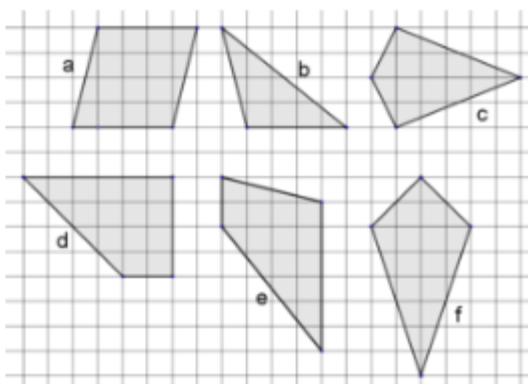
Week One:

- Calculate the area of polygons (triangles, rectangles, squares, parallelograms, trapezoids, and rhombi); compose polygons into rectangles; decompose polygons into triangles and other special quadrilaterals.

➔ Students can use tools such as the Isometric Drawing Tool on NCTM's Illuminations site to shift, rotate, color, decompose and view figures in 2D or 3D. (http://illuminations.nctm.org/ActivityDetail.aspx?ID=125)

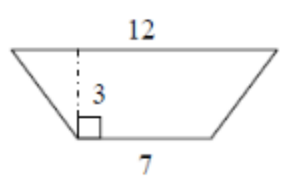
Examples:

➢ Of the polygons shown, which have equal areas? Explain how you know.



➢ Find the area of a triangle with a base length of three units and a height of four units.

➢ Find the area of the trapezoid shown below using the formulas for rectangles and triangles.



➢ A rectangle measures 3 inches by 4 inches. If the lengths of each side double, what is the effect on the area?

- ➢ The area of the rectangular school garden is 24 square units. The length of the garden is 8 units. What is the length of the fence needed to enclose the entire garden?

- ➢ The sixth-grade class at Hernandez School is building a giant wooden H for their school. The H will be 10 feet tall and 10 feet wide and the thickness of the block letter will be 2.5 feet.
    - How large will the H be if measured in square feet?
    - The truck that will be used to bring the wood from the lumber yard to the school can only hold a piece of wood that is 60 inches by 60 inches. What pieces of wood (how many and which dimensions) will need to be bought to complete the project?

Week Two:

- Draw polygons in the coordinate plane given coordinates for the vertices; find side lengths and areas of polygons in the coordinate plane.

Example:

- ➢ On a map, the library is located at (-2, 2), the city hall building is located at (0, 2), and the high school is located at (0, 0). Represent the locations as points on a coordinate grid with a unit of 1 mile.
    - What is the distance from the library to the city hall building? The distance from the city hall building to the high school? How do you know?
    - What shape is formed by connecting the three locations? The city council is planning to place a city park in this area. How large is the area of the planned park?

Week Three:

- Calculate the surface area of three-dimensional figures using nets.

- ➔ Students construct models and nets of three-dimensional figures, describing them by the number of edges, vertices, and faces. Solids include rectangular and triangular prisms.

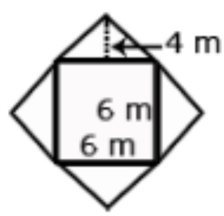
Students are expected to use the net to calculate the surface area. Students can create nets of 3D figures with specified dimensions using the Dynamic Paper Tool on NCTM's Illuminations. (http://illuminations.nctm.org/ActivityDetail.aspx?ID=205)

➔ Students also describe the types of faces needed to create a three-dimensional figure. Students make and test conjectures by determining what is needed to create a specific three-dimensional figure.

Examples:

➢ Describe the shapes of the faces needed to construct a rectangular pyramid. Cut out the shapes and create a model. Did your model work? Why or why not?

➢ Create the net for a given prism or pyramid, and then use the net to calculate the surface area.



Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 9: Volume
Pacing	One week

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

6.G.2 Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l \times w \times h$ and $V = Bh$ (where B is the area of the base of the prism) to find volumes of right

rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Calculate the volume of a right rectangular prism with fractional edge lengths	*Students will know/understand:* ● Volume formulas ● Cubic Units
● Apply the formulas $V=l \times w \times h$ and $V = Bh$ (where B is the area of the base of the prism) to find volumes of right rectangular prisms with fractional edge lengths	● Volume formulas ● Cubic Units

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is volume measured?	1. Volume is the number of cubic units that fit inside of a three-dimensional figure.
2. How does volume differ from area?	2. Volume is a measure of three-dimensional space, but area is a two-dimensional measure of the number of square units inside of a figure.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Sample Volume Lesson

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Geometric Measurement, Three-Dimensional Figures
- Desmos 4 Function Calculator

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Volume Formulas-
  - $V = l \times w \times h$ (rectangular prism)
  - $V = Bh$ (where B is the area of the base of the prism)

Learning Plan   *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of a *supporting content cluster*. Students learn to find the volume of a three-dimensional figure (prisms) using formulas and manipulatives in the context of real-world and mathematical problems.
Learning Tasks
Week One: ● Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths and show that the volume is the same as would be found by multiplying the edge lengths of the prism.   ➢ ***Sample Volume Lesson***

Westbrook Public Schools' Portrait of a Graduate   **Learning Expectations**
The Westbrook Student will meet expectations by…   ☒ Critically Problem Solving   ☐ Effectively Communicating   ☐ Creatively Thinking   ☒ Persevering   ☐ Socially Aware   ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a

Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 6 Math
Unit of Study	Unit 10: Display, Summarize and Describe Data and Statistics
Pacing	Three weeks, as time permits

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in bold are to be emphasized in the unit.)

1. **Make sense of problems and persevere in solving them.**
2. Reason abstractly and quantitatively.
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. Attend to precision.
7. Look for and make use of structure.
8. **Look for and express regularity in repeated reasoning.**

Priority/Focus Standards:

6.SP.1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one* *anticipates variability in students' ages.*

6.SP.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

6.SP.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

6.SP.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

6.SP.5 Summarize numerical data sets in relation to their context, such as by:

a. Reporting the number of observations.

b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.

c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: ● Recognize a statistical question	*Students will know/understand:* ● Statistical question

• Understand that a distribution is described by its center, spread, and overall shape	• Statistical question
	• Shape of the data distribution
	  ○ Center
	  ○ Spread
	  ○ Variability

• Recognize and find measures of center and measures of variation	• Measure of center
	  ○ Median
	  ○ Mean
	  ○ Mode
	
	• Measure of variation
	  ○ Range
	  ○ Interquartile range
	  ○ Mean absolute deviation

• Summarize numerical data sets	• Numerical data sets
	  ○ Observations
	  ○ Attributes
	  ○ Overall pattern (and deviations from)
	  ○ Choice of measures of center and variability
	  ○ Shape of the data distribution
	    ■ Center
	    ■ Spread
	    ■ Variability

• Describe an overall pattern	• Measure of center
	  ○ Median
	  ○ Mean
	  ○ Mode
	
	• Measure of variation
	  ○ Range
	  ○ Interquartile range
	  ○ Mean absolute deviation
	
	• Numerical data sets
	  ○ Observations
	  ○ Attributes

	○ Overall pattern (and deviations from) ○ Choice of measures of center and variability ○ Shape of the data distribution ■ Center ■ Spread ■ Variability
● Relate choice of measure to shape of the data	● Measure of center ○ Median ○ Mean ○ Mode ● Measure of variation ○ Range ○ Interquartile range ○ Mean absolute deviation
● Display numerical data	● Numerical data displays ○ Number line ○ Dot plot ○ Histogram ○ Box plot

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is a statistical question?	1. A statistical question anticipates variability in the data and accounts for it in the answers.
2. How can a conclusion be made about a data set?	2. Conclusions can be made about a data set based on a numerical analysis of center, variability, and spread.
3. How is numerical data displayed?	3. Numerical data is displayed using number lines, dot plots, histograms, and box plots.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 1 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media:

- Box Plot Tool: http://illuminations.nctm.org/ActivityDetail.aspx?ID=77
- Histogram Tool: http://illuminations.nctm.org/ActivityDetail.aspx?ID=78

Online Resources/Websites:

- IXL Lessons- Grade 6 Mathematics, Data & Graphs, Statistics
- Desmos 4 Function Calculator

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Statistical Question- a question that anticipates variability in the data related to the question and accounts for it in the answers.

- Mean- the average of a discrete set of numbers: specifically, the sum of the values divided by the number of values.

- Median- the middle value of a sorted set of values.

- Mode- the number(s) that occur most frequently in a data set.

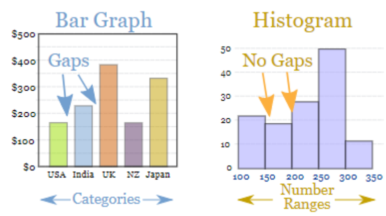
- Range- the difference between the highest and lowest numbers in a data set.

- Interquartile Range (IQR)- a measure of variability based on dividing a data set into quartiles to divide a rank-ordered data set into four equal parts; IQR is the difference between the third and first quartiles.

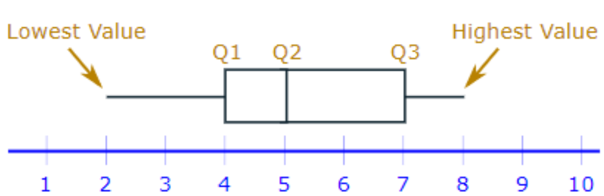
- Mean Absolute Deviation (MAD)- the average distance between each data value and the mean; a way to describe variation, or "spread" in a data set.

- Dot Plot- a number line long enough to encompass all. numbers in a sample, showing a dot over the position corresponding to each number; if more than one dot falls in the same position, they are stacked up.

- Histogram- a type of graph that represents the frequency of occurrence of specific phenomena which lie within a specific range of values, which are arranged in consecutive and fixed intervals.

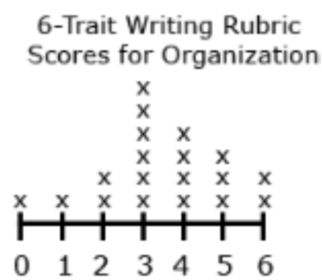


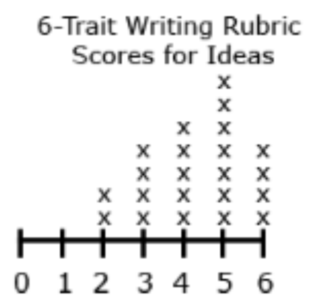
- Box Plot- a graphical representation of statistical measures showing Quartiles 1, 2 and 3 (where the data can be split into quarters) in a box, with lines extending to the lowest and highest values.



Learning Plan *Overview and Key Learning Events and Instruction Per Week*
The standards in this unit are part of an *additional content cluster*. Students move from simply representing data to analyzing data. They learn to recognize a statistical question and understand that the distribution of the data collected to answer a statistical question can be summarized in terms of center, variability, and shape. Students recognize that a measure of center summarizes all values within a given set, while a measure of variation describes how its measures vary with a single number. Students work with mean, median, and mode for measures of center and range for a measure of variation. Students represent and analyze numerical data in dot plots and histograms and reason about the most appropriate method for displaying the data. Interquartile range and mean absolute deviation are introduced. Students also learn to read, represent, and analyze box plots and to choose appropriate data display types based on the context or set of values.
Learning Tasks
Week One: ● Recognize and develop a statistical question. ➔ A *statistical question* anticipates an answer that varies from one individual to the next and is written to account for the variability in the data. Data are the numbers produced in response to a statistical question. Data is frequently collected from surveys. ➔ ***Example:*** Students might want to know about the fitness levels of the students at their school. Specifically, they want to know about the exercise habits of the students. So rather than asking "Do you exercise?" they should ask about the amount of exercise the students at their school get per week. A statistical question for this study could be: “How many hours per week on average do students at Westbrook Middle School exercise?” To collect this information, students might design a survey question that anticipates variability by providing a variety of possible anticipated responses that have numerical answers, such as: 3 hours per week, 4 hours per week, and so on. Be sure that students ask questions that have specific numerical answers. ● Understand that a distribution is described by its center, spread, and overall shape.

➔ ***Example:*** The two dot plots below show the 6-trait writing scores for a group of students on two different traits, organization, and ideas. The center, spread and overall shape can be used to compare the data sets. Students consider the context in which the data were collected and identify clusters, peaks, gaps, and symmetry. Showing the two graphs vertically rather than side by side helps students make comparisons. For example, students would be able to see from the display of the two graphs that the ideas scores are generally higher than the organization scores. One observation a student might make is that the scores for organization are clustered around a score of 3 whereas the scores for ideas are clustered around a score of 5.





Week Two:

- Calculate measures of center and measures of variation

➔ When using measures of center (mean, median, and mode) and variability (range), students are describing a data set in a single number. The range provides a single number that describes how the values vary across the data set.

Example:

➢ Consider the data shown in the dot plot of the six trait scores for organization for a group of students.

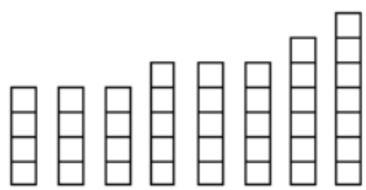
- ❑ How many students are represented in the data set?
- ❑ What is the mean, median, and mode of the data set? What do these values mean? How do they compare?
- ❑ What is the range of the data? What does this value mean?

- Summarize numerical data sets; describe an overall pattern, and relate choice of measure to shape of the data.

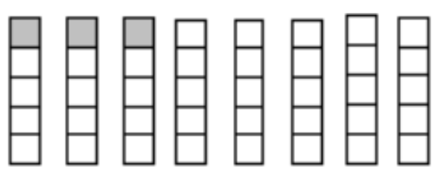
  - ➔ Students summarize numerical data by providing background information about the attribute being measured, methods and unit of measurement, the context of data collection, the number of observations, and summary statistics. Summary statistics include quantitative measures of center, spread, and variability including extreme values (minimum and maximum), mean, median, mode, range, quartiles, interquartile ranges, and mean absolute deviation.

  - ➔ The measure of center that a student chooses to describe a data set will depend upon the shape of the data distribution and context of data collection. The mode is the value in the data set that occurs most frequently. The mode is the least frequently used as a measure of center because data sets may not have a mode, may have more than one mode, or the mode may not be descriptive of the data set. The mean is a very common measure of center computed by adding all the numbers in the set and dividing by the number of values. The mean can be affected greatly by a few data points that are very low or very high (outliers). In this case, the median or middle value of the data set might be more descriptive. In data sets that are symmetrically distributed, the mean and median will be very close to the same. In data sets that are skewed, the mean and median will be different, with the median frequently providing a better overall description of the data set.

Understanding the Mean: The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and in the sense that it is a balance point. Students develop understanding of what the mean represents by redistributing data sets to be level or fair. The leveling process can be connected to and used to develop understanding of the computation of the mean. For example, students could generate a data set by drawing eight student names at random from the popsicle stick cup. The number of letters in each of the names is used to create the data set. If the names drawn were Carol, Mike, Maria, Luis, Monique, Sierra, John, and Karen there would be 3 names with 4 letters each, 3 names with 5 letters each, 1 name with 6 letters and 1 name with 7 letters. This data set could be represented with stacking cubes.

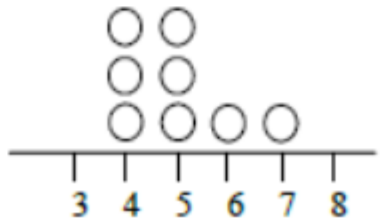


Students can model the mean by "leveling" the stacks or distributing the blocks, so the stacks are "fair." Students are seeking to answer the question "If all of the students had the same number of letters in their name, how many letters would each person have?" One block from the stack of six and two blocks from the stack of 7 can be moved down to the stacks of 4 and then all the stacks have five blocks. If all students had the same number of letters in their name, they would have five letters. The mean number of letters in a name in this data set is 5.

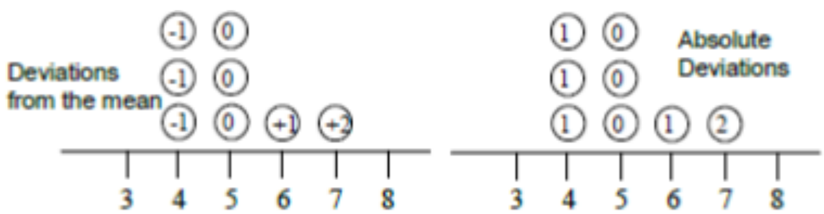


If it was not possible to make the stacks exactly even, students could begin to consider what part of the extra blocks each stack would have.

Understanding Mean Absolute Deviation: The use of mean absolute deviation in 6th grade is mainly exploratory. The intent is to build a deeper understanding of variability. Students would understand the mean distance between the pieces of data and the mean of the data set expresses the spread of the data set. Students can see that the larger the mean distance, the greater the variability. Comparisons can be made between different data sets. In the previous data set, the names drawn were Carol, Mike, Maria, Luis, Monique, Sierra, John, and Karen. There were 3 names with 4 letters each, 3 names with 5 letters each, 1 name with 6 letters and 1 name with 7 letters. This data can be represented on a dot plot. The mean of the data set is 5.



To find the mean absolute deviation, students examine each of the data points and its difference from the mean. This analysis can be represented on the dot plot itself or in a table. Each of the names with 4 letters has one fewer letter than the mean, each of the names with 5 letters has zero difference in letters as compared to the mean, each of the names with 6 letters has one more letter than the mean, and each of the names with 7 letters has two more letters than the mean. The absolute deviations are the absolute value of each difference.



Name	Number of letters in a name	Deviation from the Mean	Absolute Deviation from the Mean
John	4	-1	1
Luis	4	-1	1
Mike	4	-1	1
Carol	5	0	0
Maria	5	0	0
Karen	5	0	0
Sierra	6	+1	1
Monique	7	+2	2
Total	40	0	6

The mean of the absolute deviations is found by summing the absolute deviations and dividing by the number of data points. In this case, the mean absolute deviation would be 6 ÷ 8 or ¾ or 0.75. The mean absolute deviation is a small number, indicating that there is little variability in the data set.

Consider a different data set also containing 8 names. If the names were Sue, Joe, Jim, Amy, Sabrina, Monique, Timothy, and Adelita. Summarize the data set and its variability. How does this compare to the first data set? The mean of this data set is still 5.

$$\frac{(3+3+3+3+7+7+7)}{8} = \frac{40}{8} = 5$$

Name	Number of letters in a name	Deviation from the Mean	Absolute Deviation from the Mean
Sue	3	-2	2
Joe	3	-2	2
Jim	3	-2	2
Amy	3	-2	2
Sabrina	7	+2	2
Timothy	7	+2	2
Adelita	7	+2	2
Monique	7	+2	2
Total	40	0	16

The mean deviation of this data set is 16 ÷ 8 or 2. Although the mean is the same, there is much more variability in this data set.

Understanding Medians and Quartiles: Students can also summarize and describe the center and variability in data sets using the median and a five number summary consisting of the minimum, quartiles, and maximum. The median is the middle number of the data set with half the number below the median and half the numbers above the median. The quartiles partition the data set into four parts by dividing each of the halves of the data set into half again. Quartile 1 (Q1 or the lower quartile) is the middle value of the lower half of the data set and quartile 3 (Q3 or the upper quartile) is the middle value of the upper half of the data set. The median can also be referred to as quartile 2 (Q2). The range of the data is the difference between the minimum and maximum values. The interquartile range of the data is the difference between the lower and upper quartiles (Q3 – Q1). The interquartile range is a measure of the dispersion or spread of the data set: a small value indicates values that are clustered near the median whereas a larger value indicates values that are more distributed.

➢ ***Example:*** Ms. Wheeler asked each student in her class to write their age in months on a sticky note. The 28 students in the class brought their sticky note to the front of the room and posted them in order on the white board. The data set is listed below in order from least to greatest. Create a data display. What are some observations that can be made from the data display?

130	130	131	131	132	132	132	133	134	136
137	137	138	139	139	139	140	141	142	142
142	143	143	144	145	147	149	150		

Summary:

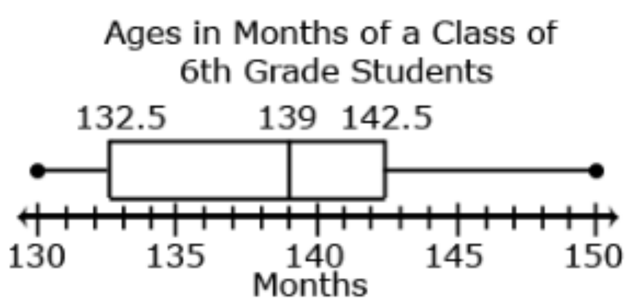
Minimum – 130 months

Quartile 1 (Q1) – (132 + 133) ÷ 2 = 132.5 months

Median (Q2) – 139 months

Quartile 3 (Q3) – (142 + 143) ÷ 2 = 142.5 months

Maximum – 150 months



This box plot shows that:

- ¼ of the students in the class are from 130 to 132.5 months old.
- ¼ of the students in the class are from 142.5 months to 150 months old.
- ½ of the class are from 132.5 to 142.5 months old.
- The median class age is 139 months.

Week Three:

- Display numerical data using dot plots, histograms, or box plots; display data graphically in a format appropriate for a given data set; read data from graphs.

  *Students can use applets to create data displays. Examples of applets include the Box Plot Tool and Histogram Tool on NCTM's Illuminations.

  - ★ Box Plot Tool: http://illuminations.nctm.org/ActivityDetail.aspx?ID=77
  - ★ Histogram Tool: http://illuminations.nctm.org/ActivityDetail.aspx?ID=78

➔ *Dot plots* are simple plots on a number line where each dot represents a piece of data in the data set. Dot plots are suitable for small to moderate size data sets and are useful for highlighting the distribution of the data including clusters, gaps, and outliers.

➔ In most real data sets, there is a large amount of data, and many numbers will be unique. A graph (such as a dot plot) that shows how many ones, how many twos, etc. would not be meaningful; however, a *histogram* can be used. Students bin the data into convenient ranges and use these intervals to generate a frequency table and histogram. Note that changing the size of the bin changes the appearance of the graph and the conclusions you may draw from it.

➔ *Box plots* (see example from week two) are another useful way to display data and are plotted horizontally or vertically on a number line. Box plots are generated from the five number summary of a data set consisting of the minimum, maximum, median, and two quartile values. Students can readily compare two sets of data if they are displayed with side-by-side box plots on the same scale. Box plots display the degree of spread of the data and the skewness of the data.

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☒ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 1: Rational Numbers: Addition and Subtraction
Pacing	Eight weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.

a. Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.*
b. Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
c. Understand subtraction of rational numbers as adding the additive inverse, $p – q = p + (–q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in real-world contexts.

d. Apply properties of operations as strategies to add and subtract rational numbers.

7.EE.3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Supporting Standard:

7.NS.3 Solve real-world and mathematical problems involving addition and subtraction with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: • Define a rational number as any number that can be expressed as the quotient (p/q) of integers, a numerator p and a non-zero denominator q.	*Students will know/understand:* • Fractions • Rational numbers
• Identify rational numbers as positive or negative fractions, decimals, or integers.	• Rational numbers
• Convert between different forms of rational numbers (decimals and fractions).	• Rational numbers • Fractions • Decimals
• Understand that rational numbers in decimal form either terminate or repeat.	• Terminating decimals • Repeating decimals
• Add and subtract rational numbers.	• Integer rules for addition and subtraction • Add/subtract fractions and mixed numbers
• Understand positive and negative direction on horizontal and vertical	• Number lines • Rational numbers in context

number lines.	
• Recognize opposite quantities and apply additive inverses.	• Opposites • Additive inverses
• Interpret sums and differences in context.	• Integer rules for addition and subtraction • Add/subtract rational numbers
• Understand subtraction as the additive inverse.	• Additive inverses
• Show that the distance between two rational numbers is the absolute value of their difference in real-world contexts.	• Absolute value • Number lines
• Evaluate absolute value.	• Absolute value • Number lines
• Solve one step addition and subtraction equations using rational numbers with and without context.	• Properties of Equality for addition and subtraction • Add/subtract rational numbers
• Write and solve one step addition and subtraction equations using rational numbers to solve real world problems.	• Rational numbers in context • Solve one-step addition and subtraction equations
• Solve multi-step real-world problems involving adding and subtracting rational numbers.	• Rational numbers in context

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is the purpose of adding and subtracting rational numbers?	1. Adding and subtracting rational numbers can be applied to describe real world concepts like sea level, temperature change, or loss of yardage in football and when evaluating expressions or solving equations.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can fluently calculate with rational numbers without the use of technology.

Informational Texts

Informational Books:
- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:
- IXL Lessons- Grade 7 Mathematics, Integers, Operations with Integers, Rational Numbers, One Variable Equations

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Integers: whole numbers and their opposites.
- Rational numbers: real numbers that can be written as a fraction in the form a/b where *a* and *b* are integers, and $\boxed{b \neq 0}$.
- Expression: a mathematical phrase that can contain numbers, variables, and operations.
- Equation: a statement that two mathematical expressions are equal.
- Opposites: two numbers that are the same distance from zero on a number line.
- Absolute Value: the positive distance away from zero on a number line.
- Zero Pairs: opposite number values whose sum is zero.
- Additive Inverse: a number that when added to a given number gives zero.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students further their knowledge of the concepts of opposites, absolute value, and integer operations. Students learn rational number addition and subtraction. Students apply knowledge of rational number operations to write and solve one-step addition and subtraction equations. Rational number applications to real-world problem solving continue in all subsequent units to increase fluency throughout the school year.

Learning Tasks

Week One:

- Students learn to describe real world situations using integers.

Example:

. Determine if each statement is true or false.

a. A $100 check deposited in a bank can be represented by +100. ☐ True ☐ False

b. A loss of 15 yards in a football game can be represented by −15. ☐ True ☐ False

c. A temperature of 20 below zero can be represented by −20. ☐ True ☐ False

d. A submarine diving 300 feet below the surface can be represented by +300. ☐ True ☐ False

- Students learn to plot and describe points on number lines and the coordinate plane.

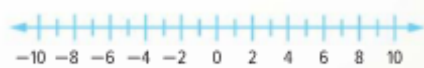
Examples:

Rachel recorded the overnight low temperatures for one week in a table.

Low Temperatures							
Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Temperature (°F)	2	−6	4	−8	2	0	−1

Plot a point on the number line for each recorded temperature.

What is the distance on the number line between the points that represent the warmest and coldest temperatures? ☐

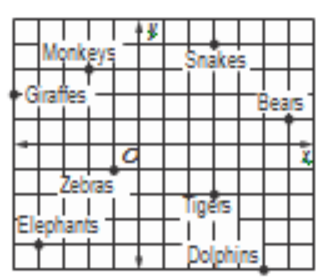


. **ZOOS** Use the map of the zoo at the right.

a. What animals are located at (−2, 3)?

b. In what quadrant are the bears located?

c. Find the ordered pair that represents the location of the dolphins.



- Students learn the concept and applications of absolute value.

Example:

Does |–13 + 2| equal |10 + 1|? If so, explain why. If not, state what each absolute value equals. 7.NS.3

Challenge:
Determine whether each state is *always, sometimes,* or *never* true. Explain your reasoning.

a. $|x| = |-x|$

b. $|x| = -|x|$

c. $|-x| = -|x|$

Week Two:

- Students evaluate numeric expressions using the order of operations; students write and evaluate algebraic expressions by substituting values.

Numeric Expressions:
Without parentheses, $8 + 30 \div 2 + 4 = 27$. Rewrite the expression on the left-hand side of the equation with parentheses so that it equals 13; then rewrite it so that is equals 23.

Algebraic Expressions:
A website charges $0.99 to download a game, and a $12.49 membership fee. Write an expression that gives the total cost in dollars to download *g* games. Then find the cost of downloading 6 games.

Challenge:
Tell whether the statement below is *sometimes, always,* or *never* true. Justify your reasoning.
The expressions x - 3 and y - 3 represent the same value.

Week Three:

- Students learn to add integers by modeling with number lines and integer chips; the concept of zero pairs (opposites) is used.

Example:

Select all of the scenarios or expressions that have a value of 0. 7.NS.1, 7.NS.1a, 7.NS.1b

- ☐ The temperature outside was –12 degrees Fahrenheit. The temperature increased 12 degrees. What is the temperature now?
- ☐ 8 + (–8)
- ☐ –5 + (–5)
- ☐ The diver was swimming at –20 feet. He came up 20 feet. What is the diver's elevation now?
- ☐ A company had a net profit of –$2,000 last year. This year, the company has a net profit of $2,000. How much did the company's net profit increase this year from last year?

➢ Simplify each expression. Sort each expression into the correct category by writing the letter of the card in the box.

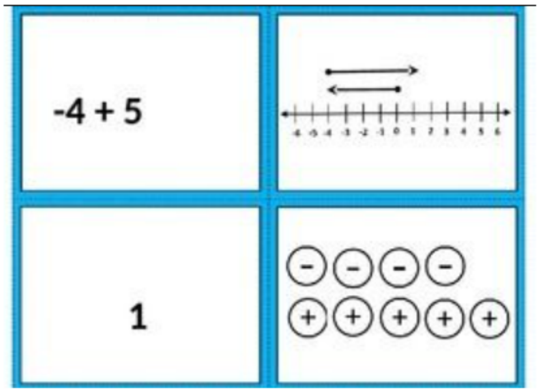
Card A	***Card B***	***Card C***
-4 + (-1)	13 + (-7) -1	-8 + |-8| + 5
Card D	***Card E***	***Card F***
|2| + (-7)	|11| + (-6)	1 – 4 + (-2)

Value equals the opposite of 5	Value equals the opposite of -5

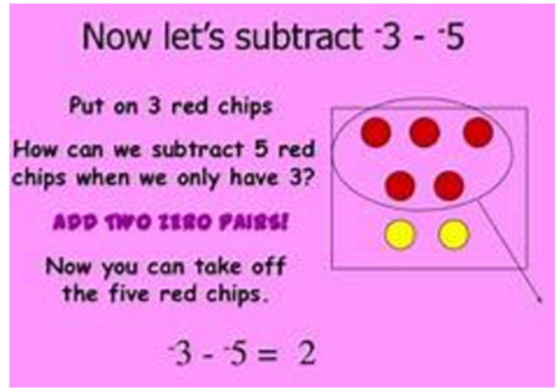
Week Four:

- Students learn to subtract integers by modeling with number lines and integer chips; students recognize that every subtraction problem can be rewritten by adding the opposite value.

Addition Model:



Subtraction Model:



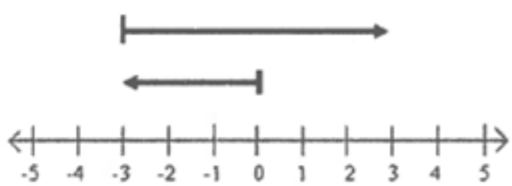
Examples:

➢ Circle an expression that is equivalent to the expression in the first column. The first one is done for you.

-3 - 1	-3 + 1	-3 + (-1)	-3 - (-1)
-2 - 9	-2 - (-9)	-2 + 9	-2 + (-9)
-8 - 4	-8 + 4	-8 + (-4)	-8 - (-4)
6 - (-2)	6 + 2	6 - 2	6 + (-2)
5 - (-7)	5 - 7	5 + (-7)	5 + 7
-1 - (-3)	-1 - 3	-1 + 3	-1 + (-3)
-3 - (-8)	-3 + 8	-3 - 8	-3 + (-8)

➢ Which equation is modeled on the number line?

a) -3 + 3 = 6 b) -3 + 6 = 3 c) -3 + (-6) = 0 d) -3 – 6 = 3



Challenge:

True or False? When *n* is a negative integer, *n* - *n* = 0. Justify your response.

Week Five:

- Students model (using algebra tiles) and solve one-step integer equations involving addition and subtraction; problem solving applications.

One Step Addition Example

The Opposite of Addition is Subtraction

$$y + 14 = 20$$
$$-14 \quad -14$$
$$y = 6 \checkmark$$

The value which makes the equation true is 6.

ONE STEP SUBTRACTION EXAMPLE

The Opposite of Subtraction is Addition

$$x - 120 = 80$$
$$+120 \quad +120$$
$$x = 200 \checkmark$$

The value which makes the equation true is 200.

Examples:

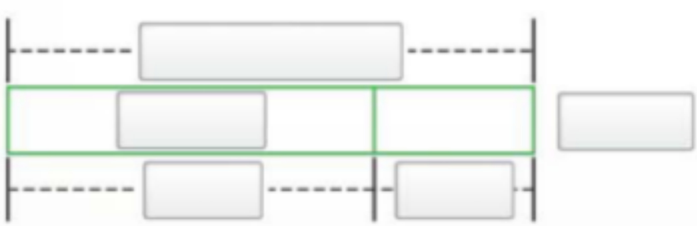
. The model represents the equation $x - 2 = 5$. Determine if each statement is true or false.

a. To solve the equation, add 2 positive counters to each side of the equation mat. ☐ True ☐ False

b. To solve the equation, add 5 negative to each side of the equation mat. ☐ True ☐ False

c. The value of x is 7. ☐ True ☐ False

. Britney practiced the piano a total of 7 hours this week. This is 3 hours less than she practiced last week. Select the correct labels to complete the bar diagram that is used to find the number of hours w Britney practiced last week.



- this week
- last week, w
- 3 hours
- 4 hours
- 7 hours
- 10 hours

How many hours did Britney practice the piano last week? ______

The sum of the measures of the angles of a triangle is 180°.
Write and solve an equation to find the missing measure.

Challenge:
Suppose $x + y = 13$ and the value of x increases by 2. If the sum remains the same, what must happen to the value of y? Justify your response.

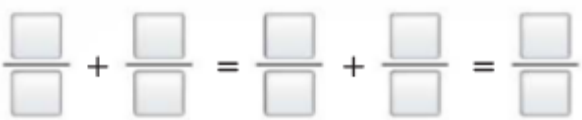
Week Six:

- Students add and subtract fractions and mixed numbers (with unlike denominators); skills are practiced individually with increasingly complex problems.

Examples:

The table shows the number of hours Orlando spent at football practice last week. Select the appropriate numbers below to complete the model to find the number of hours Orlando spent practicing on Tuesday and Friday.

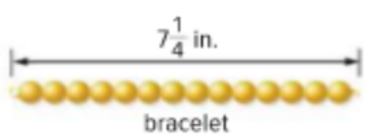
Day	Time (h)
Monday	$\frac{1}{2}$
Tuesday	$\frac{3}{4}$
Thursday	$\frac{1}{3}$
Friday	$\frac{5}{6}$



1	9
3	10
4	12
5	16
6	19

How many hours did Orlando spend practicing on Tuesday and Friday?

➢ Margarite made the jewelry shown. If the necklace is $\boxed{10\frac{5}{8}}$ in longer than the bracelet, how long is the necklace?



➢ The expression $\boxed{-5 + 1\frac{1}{8}}$ is equivalent to:

a) $\boxed{-4\frac{1}{8}}$ b) $\boxed{-3\frac{7}{8}}$ c) $\boxed{-3\frac{1}{8}}$ d) $\boxed{-6\frac{1}{8}}$

Week Seven:

- Students solve one-step rational number equations involving addition and subtraction using *properties of equality*; problem solving applications.

For word problems:

1. Define the variable.
2. Write the equation.
3. Solve, showing all steps.
4. Check/prove your solution.
5. Write a statement explaining the solution in the context of the question.

Week Eight:

- Students solve application problems involving rational numbers.

Examples:

➢ Write a numeric expression for the following situations and find the value. Explain what your answer means in the context of the question.

a) Michael had \$400 in his bank account. He withdrew \$350 for books, and \$35 for a concert ticket. Then he received a check from his parents for \$80, which he deposited. After all of these transactions, what is his new balance?

b) The height of Tom's house from ground level to the top of the roof is 23 feet. The basement floor of his house is 7 feet below the ground level. What is the distance in feet, between the top of the roof and the basement floor?

➢ Which of the following situations describes getting a temperature of 0^{o}?

- The temperature starts at 10^{o} and increases 10^{o}.
- The temperature starts at 0^{o} and then decreases 10^{o}.
- The temperature starts at -10^{o} and then decreases 10^{o}.
- The temperature starts at -10^{o} and then increases 10^{o}.

➢ The absolute value of Dudley's account is \$56. Select whether each situation gives that balance. You must prove your choice.

Yes	***No***	***Situation***
		The balance is \$153 before he withdraws \$103.
		Dudley's balance is -\$42 before he deposits \$98.

		The original balance is \$0. Dudley deposits \$18 and then withdraws \$74.

A company surveys its customers at several locations to see how well the employees are performing. The table shows the ratings. The manager at one location promises her employees a party if they end up with a positive score. Select the scenarios that would *not* result in the store getting a party. 7.EE.3

Response	Rating	Letter
Excellent	+1	A
Above average	+0.5	B
Average	0	C
Below average	–1	D
Poor	–2	F

- ☐ 13 Ds and 14 As
- ☐ 1 D, 10 Cs, and 3 Bs
- ☐ 4 As, 8 Bs, 1 C, 4 Ds, and 2 Fs
- ☐ 4 Fs and 9 Bs

Fernando, Andie, and Julio were tied for first place at math competition. The tie-breaker problem to determine the winner was to simplify the expression: $\frac{5}{8} - \frac{3}{4} - \frac{1}{6} + \frac{7}{12}$. The table shows the steps that each student took to solve the problem. 7.NS.1, 7.NS.1c, 7.NS.3

	Andie	Julio	Fernando
Step 1	$\left(\frac{5}{8} + \frac{7}{12}\right) + \left(-\frac{3}{4} - \frac{1}{6}\right)$	$\left(\frac{5}{8} + \frac{7}{12}\right) + \left(-\frac{3}{4} - \frac{1}{6}\right)$	$\left(\frac{5}{8} + \frac{7}{12}\right) + \left(-\frac{3}{4} - \frac{1}{6}\right)$
Step 2	$\left(\frac{15}{24} + \frac{14}{24}\right) + \left(-\frac{18}{24} - \frac{4}{24}\right)$	$\left(\frac{15}{24} + \frac{14}{24}\right) + \left(-\frac{18}{24} - \frac{4}{24}\right)$	$\frac{12}{20} - \frac{4}{10}$
Step 3	$\frac{29}{24} + \left(-\frac{22}{24}\right)$	$\frac{29}{24} - \frac{22}{24}$	$\frac{8}{10}$
Step 4	$\frac{51}{24}$	$\frac{7}{24}$	$\frac{4}{5}$

Part A: Who was the winner of the competition?

Part B: What errors did the other two students make?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving
☐ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 2: Rational Numbers: Multiplication and Division
Pacing	Four weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.NS.2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.

a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts.
c. Apply properties of operations as strategies to multiply and divide rational numbers.

d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.

7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)

7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10percent raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be 305 used as a check on the exact computation.*

Supporting Standard:

7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5 percent" is the same as "multiply by 1.05."*

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Multiply and divide rational numbers.	*Students will know/understand:* • Integer rules for multiplication and division • Multiply/divide fractions and mixed numbers • Equivalent forms of rational numbers
• Understand that every quotient of integers with a non-zero divisor is a rational number.	• Terminating and repeating decimals
• Solve one step multiplication and	• Properties of Equality for multiplication

division equations using rational numbers with and without context.	and division • Multiply/divide rational numbers
• Write and solve one step multiplication and division equations using rational numbers to solve real world problems.	• Rational numbers in context • Solve one-step multiplication and division equations
• Solve multi-step real-world problems involving multiplying and dividing rational numbers.	• Rational numbers in context
• Understand equivalent forms of an expression.	• Equivalent forms of expressions • Distributive Property

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is the purpose of multiplying and dividing rational numbers?	1. Multiplying and dividing rational numbers can be applied to describe real world concepts like area, volume, recipes, or money and when evaluating expressions or solving equations.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can fluently calculate with rational numbers without the use of technology.

Informational Texts

Informational Books:
- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Integers, Operations with Integers, Rational Numbers, One Variable Equations

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Integers: whole numbers and their opposites.
- Rational numbers: real numbers that can be written as a fraction.
- Expression: a mathematical phrase that contains numbers and/or variables and operators.
- Equation: a mathematical statement in which two expressions are equal.
- Multiplicative Inverse: a quantity that when multiplied by another number gives one.
- Distributive Property: to multiply a sum by a number, multiply each addend of the sum by the number a(b+c) = ab + bc.
- Coefficient: numerical quantity multiplied by a variable in an algebraic expression.
- Constant: a quantity that does not change in value regardless of the value of a variable.
- Term: a single number, variable, or product or quotient and a variable.
- Like Terms: terms in an algebraic expression that contain the same variables and powers.

Learning Plan

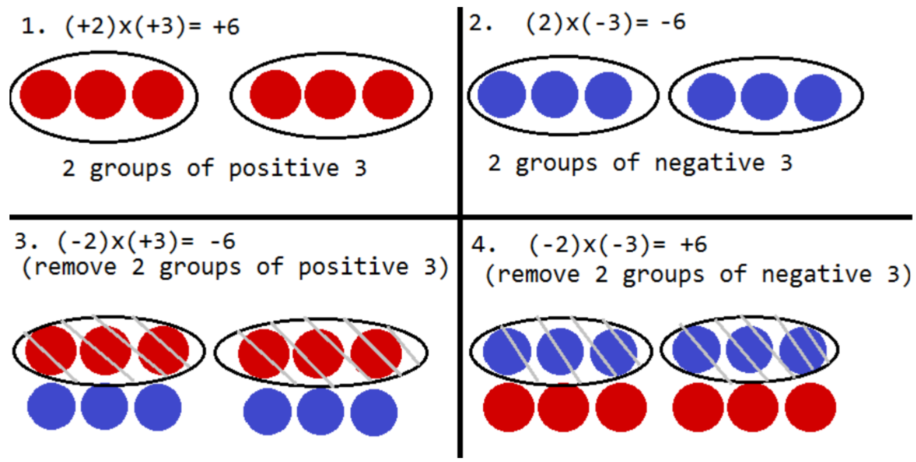
Overview and Key Learning Events and Instruction Per Week

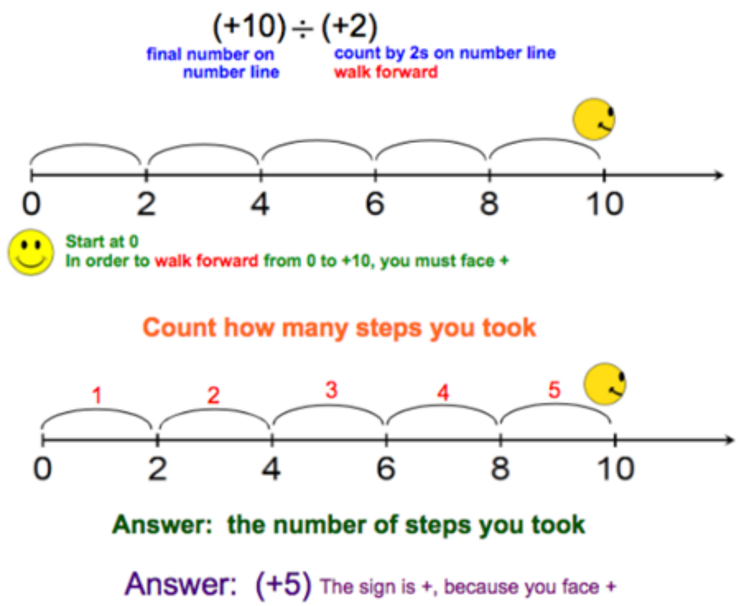
The standards in this unit are part of a *major content cluster*. Students further their knowledge of the concepts of rational numbers, opposites, absolute value, and integer operations. Students learn rational number multiplication and division. Students apply knowledge of rational number operations to write and solve one step multiplication and division equations. Rational number applications to real-world problem solving continue in all subsequent units to increase fluency throughout the school year.

Learning Tasks

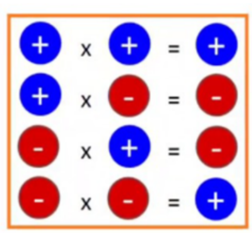
Week One:

- Students learn the rules for multiplying and dividing integers by modeling with number lines and integer chips.

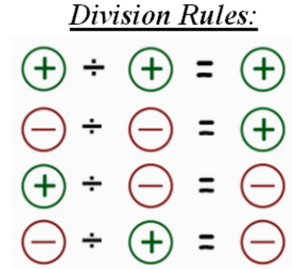




Multiplication Rules:

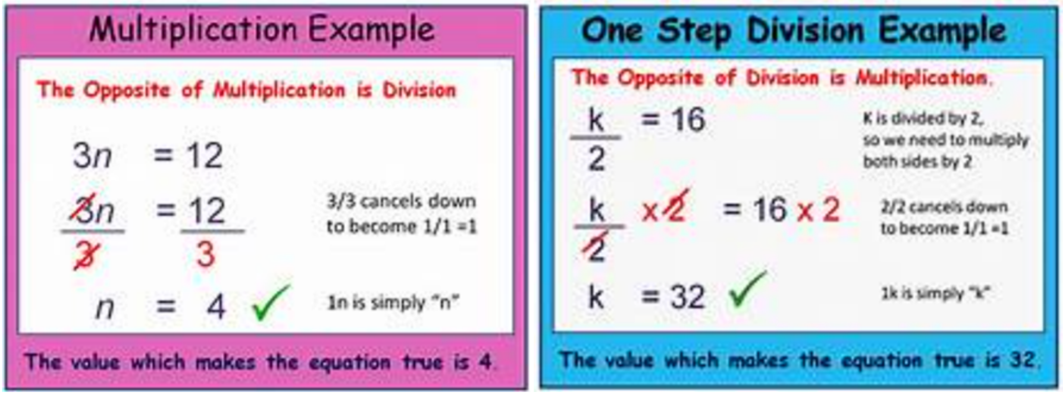


Division Rules:



Week Two:

- Students model (using algebra tiles) and solve one-step integer equations involving multiplication and division.



Week Three:

- Students multiply and divide fractions and mixed numbers; skills are practiced individually with increasingly complex problems.

Week Four:

- Students solve one-step rational number equations involving multiplication and division using *properties of equality*; problem solving applications.

For word problems:

1. Define the variable.
2. Write the equation.
3. Solve, showing all steps.
4. Check/prove your solution.
5. Write a statement explaining the solution in the context of the question.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

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Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

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Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 3: Equivalent Expressions
Pacing	Two Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. **Construct viable arguments and critique the reasoning of others.**
4. Model with mathematics.
5. Use appropriate tools strategically.
6. **Attend to precision.**
7. **Look for and make use of structure**.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standard:

7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. For example, $4x+2 = 2(2x+1)$ and $-3(x - 5/3) = -3x+5$.

Supporting Standard:

7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05." A shirt at a clothing store is on sale for 20% off the regular price, "p". The discount can be expressed as 0.2p. The new price for the shirt can be expressed as p – 0.2p or 0.8p.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Identify coefficients, variables, constants, and like terms.	*Students will know/understand:* ● Coefficients ● Variables ● Constants ● Like terms
● Combine like terms including those with rational constants and rational coefficients.	● Coefficients ● Variables ● Constants ● Like terms ● Rational number operations
● Use properties of operations (including the distributive property) to expand linear expressions, including those containing rational numbers.	● Distributive property ● Rational number operations
● Rewrite an expression in different forms to recognize how the quantities are related.	● Equivalent expressions

Essential Questions *What essential questions will be considered?*	*Corresponding Big Ideas* *What understandings are desired?*
1. When are two expressions equivalent?	1. Equivalent expressions have the same value when the variable(s) is replaced by the same number(s).

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. • Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can identify equivalent expressions without the use of technology.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems) • Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions) ***Media:*** N/A ***Online Resources/Websites:*** • IXL Lessons- Grade 7 Mathematics, Expressions and Properties

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Coefficient- a numerical or constant quantity placed before and multiplying the variable in an algebraic expression.
- Variable- a symbol (usually a letter) that represents an unknown value in an algebraic expression or equation.
- Constant- a number whose value is fixed.
- Like Terms- terms that have the same variables and powers.
- Distributive Property: a(b+c) = ab+ac.
- Equivalent Expressions- expressions have the same value when the variable(s) is replaced by the same number(s).

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. This unit reinforces rational number operations by introducing the process of simplifying and expanding expressions. Throughout the course of this unit, students apply properties of operations as strategies to add, subtract, and expand linear expressions with rational coefficients. Students rewrite expressions in different forms in problem contexts to recognize how the quantities are related. Students will apply this understanding to solve equations and inequalities in future units.

Learning Tasks

Week One:

- Students model expressions using algebra tiles to learn to identify equivalent expressions involving the distributive property and combining like terms. Expressions contain rational number coefficients and constants.

Examples:

➢ For numbers 1a–1e, select Yes or No to indicate whether each of these expressions is equivalent to $2(2x + 1)$.

1a.	$4x + 2$	◯ Yes	◯ No
1b.	$2(1 + 2x)$	◯ Yes	◯ No
1c.	$2(2x) + 1$	◯ Yes	◯ No
1d.	$2x + 1 + 2x + 1$	◯ Yes	◯ No
1e.	$x + x + x + x + 1 + 1$	◯ Yes	◯ No

➢ Suzanne thinks the two expressions 2(5a – 2) and 10a – 2 are equivalent? Is she correct? Explain why or why not?

➢ Write equivalent expressions for 3a + 12.
Possible solutions might include factoring as in 3(a + 4), or other expressions such as a + 2a + 7 + 5.

➢ A rectangle is twice as long as wide. One way to write an expression to find the perimeter would be w + w + 2w + 2w. Write the expression in two other ways.

➢ An equilateral triangle has a perimeter of 6x + 15. What is the length of each of the sides of the triangle?

Week Two:

- Students relate quantities in an expression to describe how they are related. Students write equivalent expressions to represent the same situation.

Example:

➢ Jamie and Ted both get paid an equal hourly wage of $9 per hour. This week, Ted made an additional $27 dollars in overtime. Write an expression that represents the weekly wages of both if J = the number of hours that Jamie worked this week and T = the number of hours Ted worked this week? Can you write the expression in another way?

*Students may create several different expressions depending upon how they group the quantities in the problem. One student might say: To find the total wage, I would first multiply the number of hours Jamie worked by 9. Then I would multiply the number of hours Ted worked by 9. I would add these two values with the $27 overtime to find the total wages for the week. The student would write the expression 9J + 9T +27. Another student might say: To find the total wages, I would add the number of hours that Ted and Jamie worked. I would multiply the total number of hours worked by 9. I would then add the overtime to that value to get the total wages for the week. The student would write the expression 9(J + T) + 27. A third student might say: To find the total wages, I would need to figure out how much Jamie made and add that to how much Ted made for the week. To figure out Jamie's wages, I would multiply the number of hours she worked by 9. To figure out Ted's wages, I would multiply the number of hours he worked by 9 and then add the $27 he earned in overtime. My final step would be to add Jamie and Ted wages for the week to find their combined total wages. The student would write the expression (9J) + (9T + 27).

- ***Challenge:***

Given a square pool as shown in the diagram below, write four different expressions to find the total number of tiles in the border. Explain how each of the expressions relates to the diagram and demonstrate that the expressions are equivalent. Which expression do you think is most useful? Explain your thinking.

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 4: Solving Equations and Inequalities
Pacing	Four Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.EE.4 Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.

a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?*

b. Solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solutions.*

c. Extend analysis of patterns to include analyzing, extending, and determining an expression for simple arithmetic or geometric sequences (e.g., compounding, increasing area), using tables, graphs, words, and expressions.

Supporting Standard:

7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: • Solve equations in the form px + q = r and p (x + q) = r, where p, q, and r are specific rational numbers.	*Students will know/understand:* • Models with algebra tiles • Two-step equations
• Solve real world problems by writing and solving equations.	• Equations in context
• Compare algebraic and arithmetic solutions by identifying the sequence of the operations used in each approach.	• Solution sets
• Solve inequalities of the form px + q > r or px + q < r, where p, q, and r are	• Two-step inequalities • Solution sets

specific rational numbers. This includes ≤ and ≥.	
• Graph the solution set of the inequality.	• Solution sets • Number line graphs
• Solve real world problems by writing and solving inequalities.	• Inequalities in context
• Interpret a solution set with context of a real-world problem.	• Inequalities in context • Solution sets
• Recognize angle relationships, specifically supplementary, complementary, vertical, and adjacent angles.	• Complementary angles • Supplementary angles • Vertical angles • Adjacent angles
• Apply knowledge of angle relationships to write and solve simple equations for an unknown angle in a figure.	• Angle relationships in context

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are writing and solving equations and inequalities useful?	1. Writing and solving equations and inequalities can be applied to real world problem solving involving concepts such as money, time, measurement, and geometric relationships.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can solve equations and inequalities without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

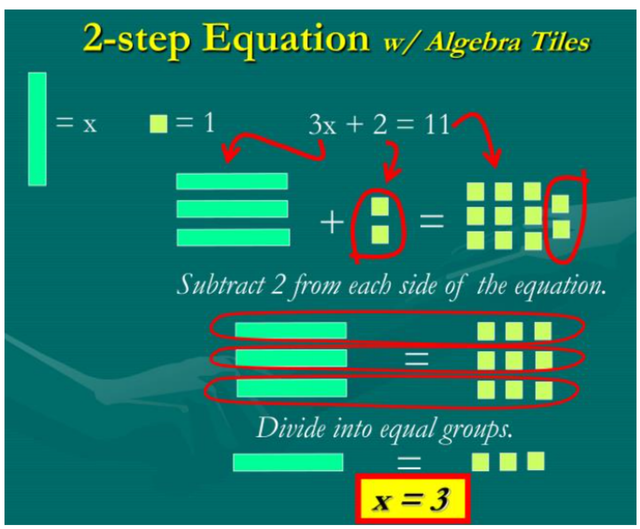
- IXL Lessons - Grade 7 Mathematics, One Variable Equations and One Variable Inequalities

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Equation: a statement of equivalence of two mathematical expressions.
- Inequality: a comparison of two values showing that one is value greater than or less than the other value.
- Solution: a value or set of values that satisfy an equation or inequality.
- Complementary angles: two angles with a sum of 90^{o}.
- Supplementary angles: two angles with a sum of 180^{o}.
- Vertical angles: pairs of opposite angles made by two intersecting lines.
- Adjacent angles: two angles that share a common vertex and common ray.

Learning Plan

Overview and Key Learning Events and Instruction Per Week
The standards in this unit are part of a *major content cluster*. Students use their prior knowledge of rational numbers and algebraic expressions to write and solve one- and two-variable equations in the context of real-world problems. Students learn to write and solve inequalities with rational numbers including ≥ and ≤. An emphasis is placed on problem solving to achieve fluency when solving equations. Students understand the relationships between angles formed by intersecting lines (supplementary, complementary, vertical, adjacent). Students solve real-world. mathematical problems involving angle measures.
Learning Tasks
Week One: ● Students model (with algebra tiles) and solve equations in the form px + q = r and p (x + q) = r, where p, q, and r are specific rational numbers.    ***<u>Challenge:</u>***

In the following equation, a and b are both integers.

$$a(3x - 8) = b - 18x$$

What is the value of a? $\boxed{}$

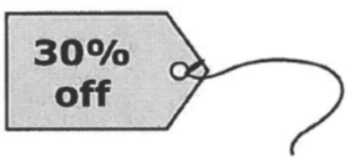
What is the value of b? $\boxed{}$

Week Two:

- Students solve real world problems by writing and solving equations in the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers; students compare algebraic and arithmetic solutions. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? To solve algebraically: 2w + 2(6) = 54. To solve arithmetically: [54 – 2(6)] ÷ 2 is the width.*

Examples:

➢ All books in a store are discounted by 30%.



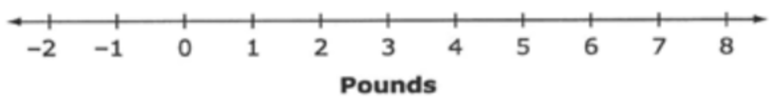
➔ <u>Part A:</u> Let x represent the regular price of any book in the store. Write an expression for the sale price of any book.

➔ <u>Part B:</u> The sale price of a book is $5.60. Write and solve an equation to find the regular price of the book.

➢ The youth group is going on a trip to the state fair. The trip costs $52. Included in that price is $11 for a concert ticket and the cost of 2 passes, one for the rides and one for the game booths. Each of the passes cost the same price. Write an equation representing the cost of the trip and determine the price of one pass.

x	x	11
52		

$$2x + 11 = 52$$
$$2x = 41$$
$$x = \$20.5$$

Week Three:
● Students solve and graph the solution set of inequalities of the form px + q > r or px + q < r, where p, q, and r are specific rational numbers. This includes ≤ and ≥. ***Example:*** David wants to buy 2 pineapples and some bananas. • The price of 1 pineapple is \$2.99. • The price of bananas is \$0.67 per pound. David wants to spend less than \$10.00. Write an inequality that represents the number of pounds of bananas, *b*, David can buy. On the number line below, draw a graph that represents the number of pounds of bananas David can buy. 
Week Four:
● Students solve real world problems by writing and solving inequalities and interpret the solution set within the context of the situation. *<u>Supporting standard</u>: Students recognize angle relationships, specifically supplementary, complementary, vertical, and adjacent angles and apply knowledge of angle relationships to write and solve simple equations for an unknown angle in a figure. ***Examples:*** ➢ Florencia has at most \$60 to spend on clothes. She wants to buy a pair of jeans for \$22 dollars and spend the rest on t-shirts. Each t-shirt costs \$8. Write an inequality for the number of t-shirts she can purchase. ➢ Steven has \$25 dollars. He spent \$10.81, including tax, to buy a new DVD. He needs to set aside \$10.00 to pay for his lunch next week. If peanuts cost \$0.38 per package including tax, what is the maximum number of packages that Steven can buy? Write and solve an inequality.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☐ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 5: Applications of Ratios and Rates
Pacing	Three Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each ¼ hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour,*

equivalently 2 miles per hour. 7.RP.2 Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate. ***Supporting Standard:*** 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: ● Use various strategies to determine whether two quantities are proportional by constructing a ratio table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.	*Students will know/understand:* ● Proportional relationships ● Ratio tables ● Graphs of proportional relationships ● Unit rates ● Constant of proportionality
● Compute unit rates with ratios of fractions including ratios of lengths, areas, and other quantities measured in like or different units.	● Proportional relationships ● Unit rates

• Identify the unit rate (constant of proportionality) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.	• Proportional relationships • Unit rates • Constant of proportionality
• Write equations for proportional relationships using the unit rate. *For example: d = 65t.*	• Proportional relationships • Equations of proportional relationships
• Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the origin and (1, r) where r is the unit rate.	• Proportional Relationships • Graphs of proportional relationships

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. In what ways can you determine whether two quantities are proportional?	1. The graph of a proportional relationship is a line passing through the origin. The equation of a proportional relationship is in the form y=kx, where k is the unit rate, or constant of proportionality.
2. What does a point (x, y) on a line through the origin represent in context of the problem?	2. The ratio of y/x is the unit rate, or constant of proportionality in the problem.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Proportional Relationships

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Ratio Table- a table that shows equivalent ratios between two quantities.
- Unit Rate- the ratio of two different units, with denominator as 1; for example, kilometer/hour, meter/sec, or miles/hour.
- Constant of Proportionality- the constant value of the ratio between two proportional quantities.
- Proportional Relationship- a relationship in which two quantities vary directly with each other; y varies directly as x if: for some constant k, called the constant of proportionality, y=kx.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. In this unit, students will decide whether two quantities are proportional, and they will learn to analyze proportional relationships. They will also solve problems involving unit rates associated with ratios of fractions. While determining proportionality, the focus should be on the understanding of equivalent ratios. Students work with equations in the form y = mx, recognizing m as the unit rate, or constant of proportionality. In future units, students will use proportional relationships to solve problems with ratios and percent.

Learning Tasks

Week One:

- Students compute unit rates with ratios of fractions including ratios of lengths, areas, and other quantities measured in like or different units; *for example, if a person walks 1/2 mile in each ¼ hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.*

- Students identify the unit rate (constant of proportionality) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

To find the CONSTANT OF PROPORTIONALITY create a chart using points from the graph.

(2, 20), (4, 40), (6, 60), etc.

Divide the POUNDS by the PRICE to find the ratio:

RATIO: 1:10
Constant = 10
Equation: y =kx
y = 10x

Pounds x	Price y
2	20
4	40
6	60
8	80
10	100

Week Two:

- Students use various strategies to determine whether two quantities are proportional by constructing a ratio table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

- ➢ Map the relationships of ratios and rates using diagrams, tables, graphs, or equations.

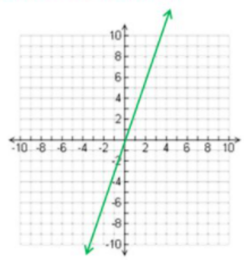
- ➢ Interpret mathematical results in the context of the situation.

- ➢ Use the unit rate (slope) to verify whether quantities are proportional.

- ➢ Plot points on a graph to check proportionality by verifying with a straight line through the origin.

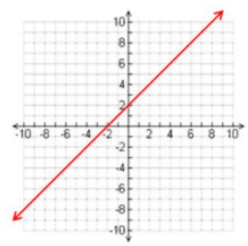
PROPORTIONAL RELATIONSHIP

Input	Output
1	3
2	6
3	9
4	12
5	15



NON-PROPORTIONAL RELATIONSHIP

Input	Output
1	2
2	3
3	4
4	5
5	6



What is the main difference between the two graphs?

The graph of a PROPORTIONAL RELATIONSHIP

is a LINE that PASSES THROUGH THE ORIGIN!

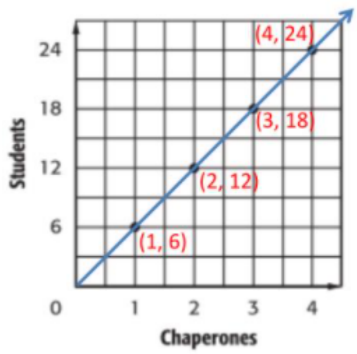
Week Three:

- Students write equations for proportional relationships using the unit rate. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.*

- Students explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the origin and (1, r) where r is the unit rate.

Writing an equation from the graph of a proportional relationship

Ex. 1) The number of students that can go on a trip is proportional to the number of chaperones that are available.



A) Find the constant of proportionality k, or the unit rate, of this relationship.

$$\frac{\text{students}}{\text{chaperones}} \qquad k = \frac{6\text{ students}}{1\text{ chaperone}}$$

$$\frac{6}{1} \qquad \frac{12}{2} = \frac{6}{1} \qquad \frac{18}{3} = \frac{6}{1} \qquad \frac{24}{4} = \frac{6}{1}$$

B) Write an equation to represent this relationship.

y = kx

No. of students   No. of chaperones

y = 6x

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Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 6: Application of Percents
Pacing	Five weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems.
Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Supporting Standard:

7.NS.A.3 Solve real-world and mathematical problems involving the four operations with rational numbers

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Convert between different forms of rational numbers (fractions decimals, and percents).	*Students will know/understand:* • Relationship between different forms of a rational number (fractions decimals, and percents)
• Utilize mental computation, estimation strategies, bar diagrams, proportions and equations to solve percent problems and assess the reasonableness of answers.	• Mental math • Estimation • Bar diagrams • Proportions • Percent equation (*part=percent x whole*)
• Solve multi-step percent problems involving mark-up and mark down, discounts, sales tax, gratuities, commissions, simple interest, percent increase and decrease, and percent error.	• Mark up/mark down • Discount • Sale price • Sales tax • Gratuities • Commission • Simple interest • Percent increase and decrease • Percent error

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What are real-life applications of percent?	1. Percent calculations can be applied to real world problems involving sales tax, gratuities, discounts, sale prices, commission, simple interest, percent increase, percent decrease, and percent error.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Percents, Consumer Math

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Percent: parts per 100.
- Simple Interest: interest paid on the original amount of a loan or account.
- Commission: fee paid for a service or work.
- Wholesale: goods sold in large quantities to retailers with the intent of the items being sold by a retailer to consumers.
- Percent Change: ratio that compares the change in a quantity to the original quantity.
- Percent Error: ratio that compares the amount of error or inaccuracy to the actual quantity.
- Sales Tax: additional amount charged when an item is purchased.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students extend their knowledge of rational number applications to include the use of percentages in solving problems. Students analyze proportional relationships and use strategies to solve real world problems involving percent, including percent increase and decrease, markups and markdowns, tax, gratuities, commission, simple interest, and percent error.

Learning Tasks

Week One:

- Students review fraction, decimal and percent equivalence; students compare number values written in all three forms.

Examples:

1) Between which two percents is ⅝? Justify your answer.

   A. 59% and 60%   B. 60% and 61%

   C. 61% and 62%   D. 62% and 63%

2) Which value is larger: 8/25 or 35%? Justify your answer.

3) Order from least to greatest: 3/50, 2/25, 0.09, 7%. Justify your answer.

   Write a percent value that is between ⅙ and ⅕ Critically Problem Solving
   Effectively Communicating
   Creatively Thinking
   Persevering
   Socially Aware

4) Responsibly Making Decisions. Justify your answer.

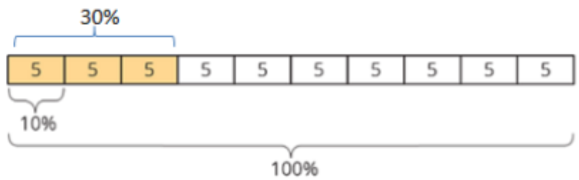
- Students solve percent of number problems for the part, whole and percent using various strategies, including mental math, bar diagrams, proportions, and equations.

Example:

Percentages and Tape Diagrams

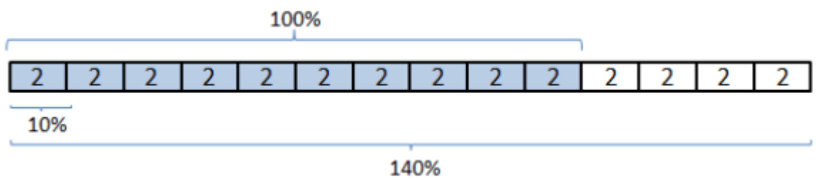
What is 30% of 50 pounds?

$50 \div 10 = 5$ Each part of the tape diagram. which represents 10%, is 5 pounds. 30% which is 3 parts is 15 pounds.



What is 100% of a number if 140% of it is 28?

$140 \div 10 = 14$ There are 14 parts in the tape diagram. Each part, which represents 10%, is 2 ($28 \div 14 = 2$). 100% which is 10 parts is 20.

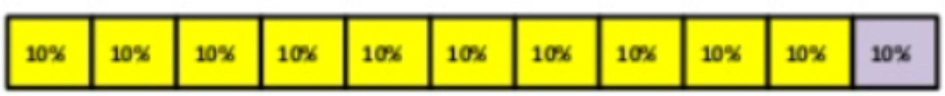


Week Two:

- Students solve real-world percent problems involving mark-up and mark down, discounts, sales tax, gratuities, commissions, and simple interest.

Example:

Anna owns a jewelry store. She has ordered a bracelet for $30 and plans on marking it up 10% to sell in the store. Find the price the bracelet will cost in the store after the 10% increase.



10% would mean using 100% ÷ 10 for the parts and each part representing 10%.

10% would mean using 1/10 and 30 ÷ 10 is 3 so each section represents $3.

The additional 10% would be an additional $3.00.

Anna's original cost of $30 plus the additional $3.00 would make the cost of the bracelet in the store $33.00.

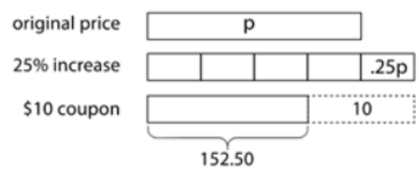
Week Three:

- Students solve percent change problems for the percent increase/decrease, the new value and the old value using various strategies, including mental math, bar diagrams, proportions and equations.

Example:

Percent Increase or Decrease

We can solve problems where there is a percent increase or decrease by using what we know about equations. For example, a camping store increases the price of a tent by 25%. A customer then uses a $10 coupon for the tent and pays $152.50. We can draw a diagram that shows first the 25% increase and then the $10 coupon.



The price after the 25% increase is p + .25p or 1.25p. An equation that represents the situation could be 1.25p – 10 = 152.50. To find the original price before the increase and discount, we can add 10 to each side and divide each side by 1.25, resulting in p = 130. The original price of the tent was $130.

$$1.25p - 10 = 152.50$$
$$1.25p = 162.50$$
$$p = 130$$

Week Four:

- Students solve real world percent problems involving percent change.

Example:

After a 25% discount, the price of a TV is $600. What was the price of the TV before the discount?

Hmmm...if you get 25% off......that means you are paying 75%...lets set up a tape diagram...

First we show what would be 100% in 4 parts because of the 25%

The 75% represents $600 and is shown to be 3 of the parts.
So $600 ÷ 3 = $200. That means each section (25%) represents $200
Which means your discount was $200 and that added onto the $600 makes the original price of the television $800.

Week Five:

- Students solve multi-step percent problems using various strategies, including mental math, bar diagrams, proportions and equations; use small group pairings of students, small group instruction/re-teaching of strategies, or independent practice.

Examples for Differentiation:

Level 1 Problems (for ***all*** students):

1) Find the result of a 30% increase if you start with $150.
2) Last year, there were 915 students at Franklin Middle School. This year the enrollment dropped by 20%. How many students go to Franklin Middle School this year?
3) A pair of jeans originally priced at $50.00 is first marked down 20% and then marked back up 20%. Find the final selling price of the jeans.
4) Skis at a sports store near Snow Summit are on sale for $476. If the original price was $560, what was the percent discount the store was offering?
5) The staff at a company increased from 32 employees to 40 employees. What is the percent increase in staff?

Level 2 Reasoning Problems (for ***all*** students):

1) Explain why is it possible to have a 150% increase, but not a 150% decrease?
2) Describe a simple way of explaining a 100% increase. Give an example to support your reasoning.
3) Can 50% more than one number be less than 1% more than another number? Give an example to support your answer.
4) Greg found the percent decrease from 120 to 100 using this reasoning: The percent increase from 100 to 120 is 20%, so the percent decrease from 120 to 100 is 20%. Is he correct? Explain.
5) Ellen needs to raise the price of a $10 item and lower the price of a $15 item so they are equal. She can only enter percent increases and percent decreases in the pricing computer. Explain how she can do this.

Level 3 Challenge Problems (for ***accelerated*** learners):

1) After a 40% discount, the sale price is $96. Find the original price.
2) After a 25% increase, the selling price of a TV was $750. Find the original cost.
3) If you add 50% of a number to itself, what percent of the result do you have to subtract to

get back to the original number? Explain/show your work.

4) A store has all board games on sale for 25% off the regular price. A checker set has a ***sale price*** of $12. The checker board set is moved to a clearance table where every item is discounted 40% off its ***regular price***. What is the ***clearance price*** of the checker board set?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
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Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 7: Theoretical and Experimental Probability
Pacing	Three Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. Attend to precision.
7. Look for and make use of structure.
8. **Look for and express regularity in repeated reasoning.**

Priority/Focus Standards:

7.SP.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is not unlikely or likely, and a probability near 1 indicates a likely event.

7.SP.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

Supporting Standards:

7.SP.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*

7.SP.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

a. Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.*
b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes of the penny appear to be equally likely based on the observed frequencies?*

Unwrapped Priority Standards	
Skills/Suggested Outcomes	***Concepts***

*What must students **do**?*	*What must students **know**?*
Students will be able to: ● Understand that the probability of a chance event is a number between 0 and 1; express probabilities as fractions, decimals, and percents.	*Students will know/understand:* ● Probability of simple events ● Probability of compound events ● Experimental vs theoretical probabilities
● Calculate the relative frequency of the event.	● Relative frequency
● Approximate the probability of a chance event by collecting data.	● Experimental probability
● Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation; understand that the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.	● Probability of compound events ● Organized lists ● Tree diagrams ● Simulations
● Represent sample spaces for compound events using methods such as organized lists, tables, and tree diagrams.	● Sample space ● Organized lists ● Tree diagrams
● Design and use a simulation to generate frequencies for compound events.	● Simulations

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is probability, and how can it be used to describe the likelihood of an event?	1. Probability expresses the likelihood of the event occurring represented as a number from 0-1. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event. A probability around 1/2

	indicates an event that is neither unlikely or likely.
2. What is the difference between experimental and theoretical probability, and how can these ideas be used to make predictions?	2. Theoretical probability is what is expected to happen. Experimental probability is what actually happens in a trial. As more trials are conducted, the experimental probability generally gets closer to the theoretical probability.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Probability

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Theoretical probability - How likely an event is to occur represented by a number from 0-1, found by the number of favorable outcomes divided by the total number of possible outcomes.
- Experimental probability - the ratio of the number of times an event occurs to the total number of trials or times the activity is performed.
- Relative frequency - the ratio of the frequency of a particular event in a statistical experiment to the total frequency.
- Simple event - A single event.
- Compound event - consists of two or more events.
- Sample Space - the set of all possible outcomes of that experiment
- Probability model - is a mathematical representation of a random phenomenon. It is defined by its sample space, events within the sample space, and probabilities associated with each event.
- Simulation - a way of collecting probability data using actual objects, such as coins, spinners, and cards.

Learning Plan

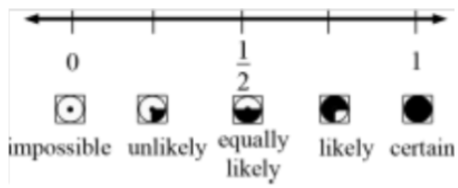
Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *supporting content cluster*. Students understand that the probability of a chance event is a number between 0 and 1 (written as a fraction, decimal or percent value) that expresses the likelihood of the event occurring. They collect data on a chance event and predict its relative frequency. Students develop a probability model and use it to find the probability of an event. They compare theoretical and experimental probabilities. Students find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

Learning Tasks

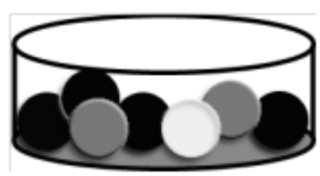
Week One:

- Students understand that the probability of a chance event is a number between 0 and 1, and express probabilities as fractions, decimals, and percents.



Example:

The container below contains 2 gray, 1 white, and 4 black marbles. Without looking, if you choose a marble from the container, will the probability be closer to 0 or to 1 that you will select a white marble? A gray marble? A black marble? Justify each of your predictions.



Week Two:

- Students approximate the probability of a chance event by collecting data and then compare experimental and theoretical probabilities of an event.

- Students calculate the relative frequency of the event.

<u>Experimental vs. Theoretical Probability</u>

When asked about the probability of a coin landing on heads, you would

probably answer that the chance is ½ or 50%.

Imagine that you toss that same coin 20 times. How many times would you expect it to land on heads? You might say, 50% of the time, or half of the 20 times. So, you would expect it to land on heads 10 times. This is the theoretical probability.

The theoretical probability is what you expect to happen, but it isn't always what happens. The table below shows the results after Sunil tossed the coin 20 times.

Outcomes	Frequency
Heads	13
Tails	7
Total	20

This shows the experimental probability. You can think of it as the probability determined from the results of an experiment. It is what actually happens instead of what you were expecting to happen.

The experimental probability of landing on heads is $\frac{13}{20} = \frac{65}{100} = 0.65 = 65\%$.

It landed on heads more times than we expected.

Now, Sunil continues to toss the same coin for 50 total tosses. The results are shown below.

Outcomes	Frequency
Heads	26
Tails	24
Total	50

Now the experimental probability of landing on heads is

$$\frac{26}{50} = \frac{52}{100} = 0.52 = 52\%$$

Outcome	Frequency
1	16
2	20
3	22
4	10
5	18
6	14
Total	**100**

a. Rolling a 3 (use the table)

$$\frac{22}{100} = 0.22 = 22\%$$

b. What is the theoretical probability of rolling a 3?

$$\frac{1}{6} = 0.166666\ldots \approx 17\%$$

c. Rolling a number less than 3 (use the table)

(Rolling a 1 or 2) $\frac{36}{100} = 0.36 = 36\%$

d. Rolling a 3 or a 5 (use the table)

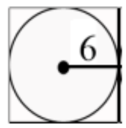
$$\frac{40}{100} = 0.40 = 40\%$$

*Students need multiple opportunities to perform probability experiments and compare these results to theoretical probabilities. Critical components of the experiment process are making predictions about the outcomes by applying the principles of theoretical probability, comparing the predictions to the outcomes of the experiments, and replicating the experiment to compare results. Experiments can be replicated by the same group or by compiling class data. Experiments can be conducted using various random generation devices including, but not limited to, bag pulls, spinners, number cubes, coin toss, and colored chips. As a challenge, students can also develop models for geometric probability (i.e., a target).

Example:

➢ Each group receives a bag that contains 4 green marbles, 6 red marbles, and 10 blue marbles. Each group performs 50 pulls, recording the color of marble drawn and replacing the marble into the bag before the next draw. Students compile their data as a group and then as a class. They summarize their data as experimental probabilities and make conjectures about theoretical probabilities (How many green draws would you expect if you were to conduct 1000 pulls? 10,000 pulls?). Students create another scenario with a different ratio of marbles in the bag and make a conjecture about the outcome of 50 marble pulls with replacement. An example would be 3 green marbles, 6 blue marbles, and 3 blue marbles. Students try the experiment and compare their predictions to the experimental outcomes to continue to explore and refine conjectures about theoretical probability.

➔ ***Challenge:*** If you choose a point in the square, what is the probability that it is not in the circle?



Week Three:

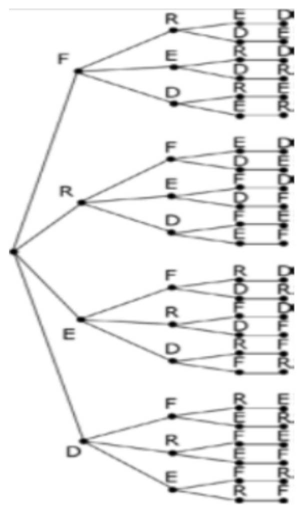
- Students represent the sample space and identify the outcomes in the sample space that compose the compound event.
- Students find the probabilities of compound events using organized lists, tables, tree diagrams, and simulations.
- Students understand that the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
- Students design and use a simulation to generate frequencies for compound events.

Examples:

1) Students conduct a bag pull experiment. A bag contains 5 marbles. There is one red marble, two blue marbles and two purple marbles. Students draw one marble without replacement and then draw another. What is the sample space for this situation? Explain how you determined the sample space and how you will use it to find the probability of drawing one blue marble followed by another blue marble.

➔ ***Challenge:*** Determine whether the events are independent or dependent based on whether the experiment is done with or without replacement. Repeat the experiment both ways.

2) Show all possible arrangements of the letters in the word FRED using a tree diagram. If each of the letters is on a tile and drawn at random, what is the probability that you will draw the letters F-R-E-D in that order? What is the probability that your "word" will have an F as the first letter?



Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 8: Sampling and Statistics
Pacing	Two Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.SP.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

7.SP.2 Use data from a random sample to draw inferences about a population with an unknown

characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.

Draw informal comparative inferences about two populations.

Supporting Standards:

7.SP.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team and both distributions have similar variability (mean absolute deviation) of about 5 cm. The difference between the mean heights of the two teams (10 cm) is about twice the variability (5cm) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.

7.SP.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth- grade science book.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Understand that validity depends on the sample being representative of the population.	*Students will know/understand:* ● Random sample ● Population

• Use a random sample to gain statistical information and draw inferences about a population.	• Random sample • Inferences
• Generate multiple samples of the same size to assess the variation (spread of data) in estimates or predictions. *For example, predict the winner of a school election based on randomly sampled survey data.*	• Random sample • Variation
• Compare two data distributions of similar variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team.*	• Mean absolute deviation
• Use measures of center and measures of variability (mean absolute deviation) to draw informal comparisons about two populations.	• Measures of center (mean, median, mode, range) • Measures of variability (mean absolute deviation)

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How can samples be used to make inferences about a population?	1. The larger the sample, the stronger the inference about the population and the smaller the sample, the weaker the inference about the population.
2. How can data displays, measures of center and measures of variability from random samples be used to draw informal comparative inferences about two populations?	3. Mean and median can easily be examined. The variability between the two data sets can also be compared.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Data & Graphs and Statistics

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Sample- a small part or quantity intended to represent the whole.
- Random Sample- a subset of a statistical population in which each member of the subset has an equal probability of being chosen. A simple random sample is meant to be an unbiased representation of a group.
- Population- is a whole, it's every member of a group.

- Mean- the average of a data set.
- Median- the middle of the set of numbers.
- Variability (mean absolute deviation) - the average distance between each data point and the mean.

Learning Plan   *Overview and Key Learning Events and Instruction Per Week*
The standards about using random sampling to draw inferences about a population (7. SP.1 and 7.SP.2) are part of a *supporting cluster*. The standards about drawing informal comparative inferences about two populations (7. SP.3 and 7.SP.4) are part of an *additional cluster*. Students compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.
Learning Tasks
Week One: • Students understand that validity depends on the sample being representative of the population, and then use a random sample to gain statistical information and draw inferences about a population.   ***Examples:***   1) The school food service wants to increase the number of students who eat hot lunch in the cafeteria. The student council has been asked to conduct a survey of the student body to determine the students' preferences for hot lunch. They have determined two ways to do the survey. The two methods are listed below. Identify the type of sampling used in each survey option. Which survey option should the student council use and why?   a) Write all the students' names on cards and pull them out in a draw to determine who will complete the survey.   OR   b) Survey the first 20 students that enter the lunchroom.

2) Below is the data collected from two random samples of 100 students regarding student's school lunch preferences. Make at least two inferences based on the results.

Lunch Preferences

student sample	hamburgers	tacos	pizza	total
#1	12	14	74	100
#2	12	11	77	100

Week Two:

- Students use measures of center and measures of variability (mean absolute deviation) to draw informal comparisons about two populations.

Example:

Jason wanted to compare the mean height of the players on his favorite basketball and soccer teams. He thinks the mean height of the players on the basketball team will be greater but doesn't know how much greater. He also wonders if the variability of heights of the athletes is related to the sport they play. He thinks that there will be a greater variability in the heights of soccer players as compared to basketball players. He used the rosters and player statistics from the team websites to generate the following lists.

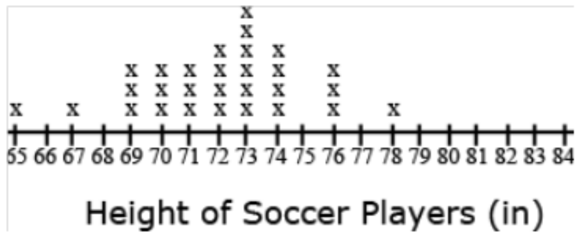
Basketball Team – Height of Players in inches for 2010-2011 Season

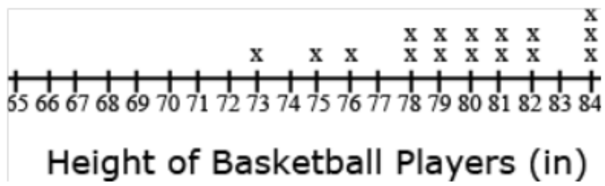
75, 73, 76, 78, 79, 78, 79, 81, 80, 82, 81, 84, 82, 84, 80, 84

Soccer Team – Height of Players in inches for 2010

73, 73, 73, 72, 69, 76, 72, 73, 74, 70, 65, 71, 74, 76, 70, 72, 71, 74, 71, 74, 73, 67, 70, 72, 69, 78, 73, 76, 69

To compare the data sets, Jason creates a two-dot plot on the same scale. The shortest player is 65 inches, and the tallest players are 84 inches.





In looking at the distribution of the data, Jason observes that there is some overlap between the two data sets. Some players on both teams have players between 73 and 78 inches tall. Jason decides to use the mean and mean absolute deviation to compare the data sets. Jason sets up a table for each data set to help him with the calculations.

The mean height of the basketball players is 79.75 inches as compared to the mean height of the soccer players at 72.07 inches, a difference of 7.68 inches.

The mean absolute deviation (MAD) is calculated by taking the mean of the absolute deviations for each data point. The difference between each data point and the mean is recorded in the second column of the table. Jason used rounded values (80 inches for the mean height of basketball players and 72 inches for the mean height of soccer players) to find the differences. The absolute deviation, absolute value of the deviation, is recorded in the third column. The absolute deviations are summed and divided by the number of data points in the set.

The mean absolute deviation is 2.14 inches for the basketball players and 2.53 for the soccer players. These values indicate moderate variation in both data sets. There is slightly more variability in the height of the soccer players. The difference between the heights of the teams is approximately 3 times the variability of the data sets ($7.68 \div 2.53 = 3.04$).

Soccer Players (n = 29)		
Height (in)	Deviation from Mean (in)	Absolute Deviation (in)
65	-7	7
67	-5	5
69	-3	3
69	-3	3
69	-3	3
70	-2	2
70	-2	2
70	-2	2
71	-1	1
71	-1	1
71	-1	1
72	0	0
72	0	0
72	0	0
72	0	0
73	+1	1
73	+1	1
73	+1	1
73	+1	1
73	+1	1
73	+1	1
74	+2	2
74	+2	2
74	+2	2
74	+2	2
76	+4	4
76	+4	4
76	+4	4
78	+6	6
Σ = 2090		Σ = 62

Mean = 2090 ÷ 29 =72 inches
MAD = 62 ÷ 29 = 2.13 inches

Basketball Players (n = 16)		
Height (in)	Deviation from Mean (in)	Absolute Deviation (in)
73	-7	7
75	-5	5
76	-4	4
78	-2	2
78	-2	2
79	-1	1
79	-1	1
80	0	0
80	0	0
81	1	1
81	1	1
82	2	2
82	2	2
84	4	4
84	4	4
84	4	4
Σ = 1276		Σ = 40

Mean = 1276 ÷ 16 =80 inches
MAD = 40 ÷ 16 = 2.5 inches

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 9: Circumference of Circles; Area of Polygons and Circles
Pacing	Two Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standard:

7.G.B.4 Know the formulas for the area and circumference of a circle and solve problems.

Supporting Standard: 7.G.B.6 Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Calculate the area of two-dimensional polygons including composite figures.	*Students will know/understand:* ● Polygons ● Composite figures ● Area formulas for two dimensional polygons (triangles, rectangles, parallelograms, and trapezoids)
● Solve conceptual and real-world problems involving areas of polygons.	● Polygons in context
● Understand that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle.	● Circles ● Radius ● Diameter ● Pi
● Describe the relationships among the radius, diameter, and circumference of a circle.	● Radius ● Diameter ● Pi
● Calculate the area and circumference of a circle using the formulas.	● Circumference formula ● Area formula of a circle
● Solve real-world problems involving area and circumference of circles.	● Circles in context

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is calculating the area of polygons including composite figures useful?	1. Calculating the area of polygons and composite figures can be applied to real world problem solving involving concepts such measurement and geometric relationships like carpeting a room, buying paint to paint a wall, or planting a garden including non-regular shapes.
2. How is calculating the circumference and area of circles useful?	2. Calculating the circumference and area of circles can be applied to real world problem solving involving concepts such measurement and geometric relationships like fencing in a circular space, planting a circular garden, or designing a circular sign.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)

- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons - Grade 7 Mathematics, Geometric Measurement

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Polygon: two-dimensional figure with at least three straight sides and angles.
- Composite figure: two-dimensional figure that consists of basic two-dimensional shapes.
- Parallelogram: four-sided plane figure with two sets of opposite sides that are parallel and congruent.
- Trapezoid: quadrilateral with only one set of parallel sides.
- Circle: two-dimensional closed figure in which all points are equidistant from the center.
- Radius: line segment from the center of a circle to the circumference.
- Diameter: line segment that passes through the center of a circle with endpoints on the circumference of the circle.
- Pi: the ratio of the circumference of a circle to its diameter.
- Circumference: the distance around a circle.

Learning Plan

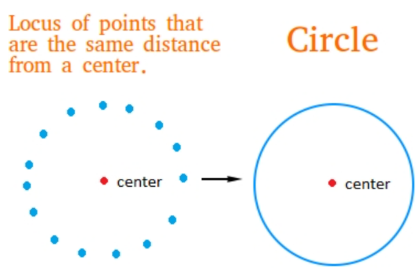
Overview and Key Learning Events and Instruction Per Week

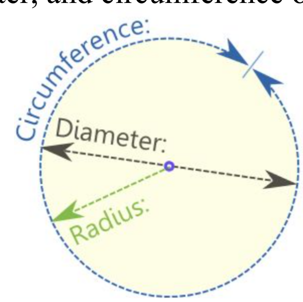
The standards in this unit are part of an *additional content cluster*. Students learn to calculate the areas of various polygons, including composite figures. An emphasis is on understanding, learning, and applying the formulas to find the circumference and area of circles. Students apply the formulas of circumference and areas of polygons and circles to solve real world problems. In future units, students will extend their knowledge of area to calculate surface area and volume of cubes and right prisms.

Learning Tasks

Week One:

- Students understand that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle; students are able to describe the relationships among the radius, diameter, and circumference of a circle.





- Students calculate the area and circumference of a circle using the formulas, and students solve real-world problems involving area and circumference of circles.

<u>Formulas</u>:

$$C = \pi \cdot d$$

$$A = \pi \cdot r^2$$

Examples:

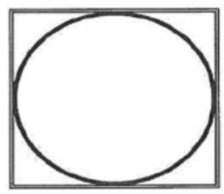
➔ Basil saw a strange old bicycle at the museum. It had one very big wheel and one very small one. It was called an “Ordinary” or a “Penny Farthing.” At home Basil looked it up on the internet and found that the big wheel could have a 52-inch diameter and the small wheel could have an 18-inch diameter.

1) What is the circumference of the big wheel? Give your answer in inches.
2) How far would you travel in one turn of the big wheel? Give your answer in feet and inches?
3) How many times must the cyclist turn the big wheel to travel 1 mile? A mile is 1760 yards. Give your answer to the nearest 10 turns.

4) How many times does the small wheel turn when the cycle travels 1 mile?

➔ ***Challenge:***

An artist used silver wire to make a square that has a perimeter of 40 inches. She then used copper wire to make the largest circle that could fit in the square, as shown below.



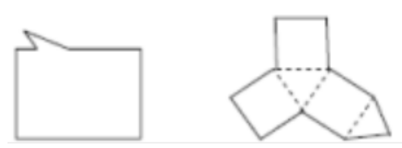
How many more inches of silver wire did the artist use compared to copper wire? (Use $\pi = 3.14$) Show all work necessary to justify your response.

Week Two:

- Students calculate the area of two-dimensional polygons including composite figures, and then solve conceptual and real-world problems involving areas of polygons. Students' understanding of volume can be supported by focusing on the area of base times the height to calculate volume. Students' understanding of surface area can be supported by focusing on the sum of the area of the faces. Nets can be used to evaluate surface area calculations.

Examples:

1) Choose one of the figures shown below and write a step-by-step procedure for determining the area. Find another person that chose the same figure as you did. How are your procedures the same and different? Do they yield the same result?



2) Find the area of a triangle with a base length of three units and a height of four units.
3) Find the area of the trapezoid shown below using the formulas for rectangles and triangles.

Westbrook Public Schools' Portrait of a Graduate   **Learning Expectations**
The Westbrook Student will meet expectations by…   ☒ Critically Problem Solving   ☐ Effectively Communicating   ☐ Creatively Thinking   ☒ Persevering   ☐ Socially Aware   ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 10: Surface Area; Volume; Slicing Solids
Pacing	Three Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standard:

7.G.B.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Supporting Standard:

7.G.A.3 Describe the shape of the two-dimensional face of the figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Solve real-world and mathematical problems involving area and surface area of figures composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	*Students will know/understand:* ● Area of a parallelogram, quadrilateral, square, rectangle, rhombus, trapezoid ● Two-dimensional vs. three dimensional figures ● Prism vs. pyramid ● Surface area in context
● Solve real-world and mathematical problems involving volume of right rectangular and triangular prisms.	● Volume of right rectangular prism ● Volume of right triangular prism
● Describe the two-dimensional figures that result from slicing right rectangular prisms and pyramids.	● Cross-sections

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is calculating the surface area and volume of three-dimensional figures useful?	1. Calculating the surface area and volume of three-dimensional figures can be applied to real world problem solving involving concepts such measurement

	and geometric relationships like building a box, painting a room, or filling a pool.
2. How are the two-dimensional shapes that result from slicing a prism or pyramid determined?	2. The shape of the cross sections depends on whether the cut is parallel, perpendicular, or at an angle to the base.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons - Grade 7 Mathematics, Three-Dimensional Figures and Geometric Measurement

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Quadrilateral: two-dimensional four-sided figure.
- Parallelogram: quadrilateral with two sets of opposite sides that at parallel and congruent.
- Rectangle: quadrilateral with two sets of parallel sides and four right angles.
- Square: quadrilateral with four congruent sides and four right angles.
- Rhombus: parallelogram with opposite, congruent angles.
- Trapezoid: quadrilateral with only one set of parallel sides.
- Two-dimensional figure: figure that lies on one plane.
- Three-dimensional figure: figure with length, width, and height such as prisms and pyramids.
- Prism: three-dimensional figure with opposite, congruent bases.
- Pyramid: three-dimensional figure with a polygon as a base and triangular sides that meet at a point.
- Volume: three-dimensional space occupied by a figure.
- Surface area: sum of the area of the faces of a three-dimensional object.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of an *additional content cluster*. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections and nets. Students solve real-world and mathematical problems involving surface area and volume of three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Learning Tasks

Week One:

- Students solve real-world and mathematical problems involving area and surface area of figures composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Examples:

➢ The seventh-grade class is building a mini golf game for the school carnival. At the end of the 20-foot-long rectangular putting green there will be a semicircle. If the semi-circle is 10 feet in diameter, how many square feet of grass carpet will they need to buy to cover the entire putting green? Hint: Draw a diagram to help you.

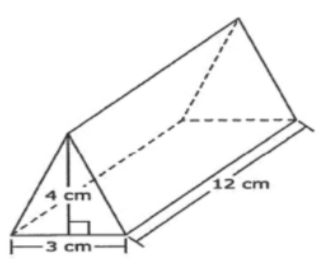
➢ Students measure the circumference and diameter of several circular objects in the room (clock, trash can, doorknob, wheel, etc.). Students organize their information and discover the relationship between circumference and diameter by noticing the pattern in the ratio of the measures. Students write an expression that could be used to find the circumference of a circle with any diameter and check their expression on other circles.

Week Two:

- Students solve real-world and mathematical problems involving volume of right rectangular and triangular prisms.

Examples:

➢ Find the volume (in cubic cm) of the triangular prism:

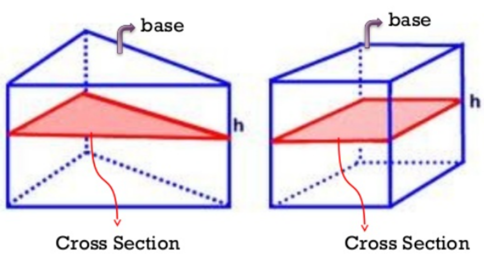


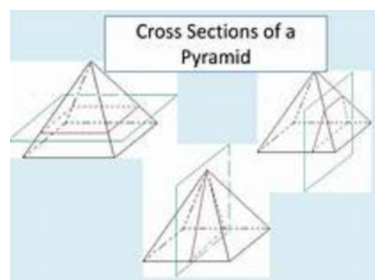
➢ A cereal box is a rectangular prism. Measure the dimensions of a cereal box. What is the volume of the cereal box? What is the surface area of the cereal box? Hint: Create a net of the cereal box and use the net to calculate the surface area.

Week Three (if time permits):

- Students describe the two-dimensional figures that result from slicing right rectangular prisms and pyramids.

Parallel Cross-Sections of Prisms





Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 11: Geometric Drawing and Scaling
Pacing	Two Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in ***bold*** *are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standard:

7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing, and reproducing a scale drawing at a different scale.

Supporting Standard:

7.G.A.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: ● Solve problems involving scale drawings of geometric figures.	*Students will know/understand:* ● Scale factor ● Reduction ● Enlargement
● Construct a scale drawing at a different scale.	● Scale drawing
● Calculate actual lengths and areas from a scale drawing.	● Scale factor ● Reduction ● Enlargement
● Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.	● Construction
● Construct triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.	● Construction

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are constructions of geometric shapes using scale factors useful?	1. Constructing geometric shapes and scale drawings can be applied to real world problem solving involving concepts such measurement and geometric relationships like building a scale model, architecture and construction, or map scale.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems) • Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions) ***Media:*** • Geometry software ***Online Resources/Websites:*** • IXL Lessons - Grade 7 Mathematics Ratios, Rates, and Proportions and Two-

Dimensional Figures

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- <u>Scale factor</u>: ratio between corresponding measurements of an object or figure and a representation of the figure.
- <u>Reduction</u>: similar figure resulting from decreasing the size of the original figure.
- <u>Enlargement</u>: similar figure resulting from increasing the size of the original figure.
- <u>Construction</u>: geometric drawing of figures using accurate angles, shapes, and lines.

Learning Plan

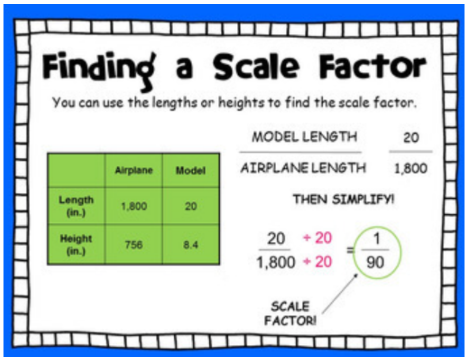
Overview and Key Learning Events and Instruction Per Week

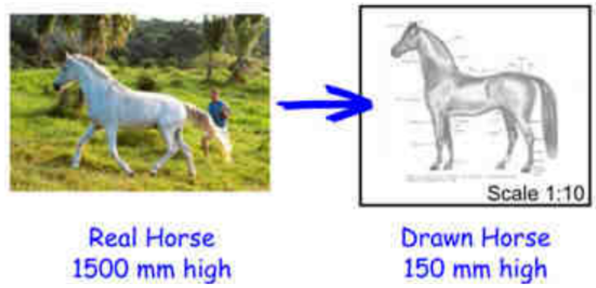
The standards in this unit are part of an *additional content cluster*. The emphasis is on drawing, constructing, and describing geometrical figures and describing their relationships. Students understand that a scale factor is applied to all side lengths of a drawing to create the new drawing or construction. Students reason about relationships among two-dimensional figures using scale and solve problems involving scale drawings and geometric constructions. Tools such as rulers and protractors are used to construct shapes either by hand or using computer technology. Students build on learning from previous units in regarding the relationships between angles formed by intersecting lines and work with three-dimensional figures, relating them to two-dimensional figures by examining cross sections (slicing).

Learning Tasks

Week One:

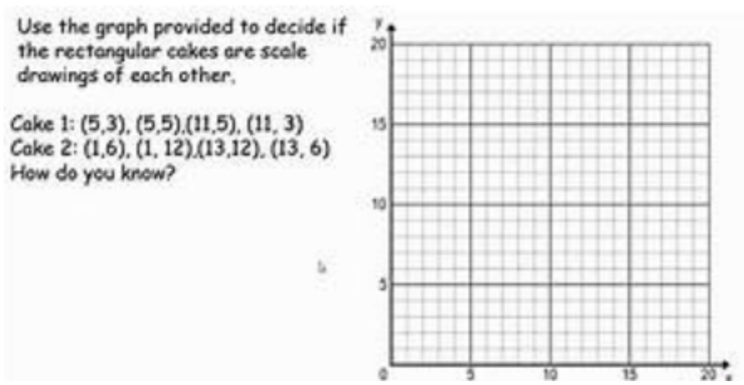
- Students construct a scale drawing at a different scale and calculate actual lengths and areas from a scale drawing.





- Students solve problems involving scale drawings of geometric figures.

Example:



Week Two:

- Students draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.

- Students construct triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 1: Rational Numbers: Addition and Subtraction
Pacing	Eight weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.

a. Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.*
b. Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
c. Understand subtraction of rational numbers as adding the additive inverse, $p – q = p + (–q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in real-world contexts.

d. Apply properties of operations as strategies to add and subtract rational numbers.

7.EE.3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Supporting Standard:

7.NS.3 Solve real-world and mathematical problems involving addition and subtraction with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Define a rational number as any number that can be expressed as the quotient (p/q) of integers, a numerator p and a non-zero denominator q.	*Students will know/understand:* • Fractions • Rational numbers
• Identify rational numbers as positive or negative fractions, decimals, or integers.	• Rational numbers
• Convert between different forms of rational numbers (decimals and fractions).	• Rational numbers • Fractions • Decimals
• Understand that rational numbers in decimal form either terminate or repeat.	• Terminating decimals • Repeating decimals
• Add and subtract rational numbers.	• Integer rules for addition and subtraction • Add/subtract fractions and mixed numbers
• Understand positive and negative direction on horizontal and vertical	• Number lines • Rational numbers in context

number lines.	
• Recognize opposite quantities and apply additive inverses.	• Opposites • Additive inverses
• Interpret sums and differences in context.	• Integer rules for addition and subtraction • Add/subtract rational numbers
• Understand subtraction as the additive inverse.	• Additive inverses
• Show that the distance between two rational numbers is the absolute value of their difference in real-world contexts.	• Absolute value • Number lines
• Evaluate absolute value.	• Absolute value • Number lines
• Solve one step addition and subtraction equations using rational numbers with and without context.	• Properties of Equality for addition and subtraction • Add/subtract rational numbers
• Write and solve one step addition and subtraction equations using rational numbers to solve real world problems.	• Rational numbers in context • Solve one-step addition and subtraction equations
• Solve multi-step real-world problems involving adding and subtracting rational numbers.	• Rational numbers in context

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is the purpose of adding and subtracting rational numbers?	1. Adding and subtracting rational numbers can be applied to describe real world concepts like sea level, temperature change, or loss of yardage in football and when evaluating expressions or solving equations.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can fluently calculate with rational numbers without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Integers, Operations with Integers, Rational Numbers, One Variable Equations

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Integers: whole numbers and their opposites.
- Rational numbers: real numbers that can be written as a fraction in the form a/b where *a* and *b* are integers, and $\boxed{b \neq 0}$.
- Expression: a mathematical phrase that can contain numbers, variables, and operations.
- Equation: a statement that two mathematical expressions are equal.
- Opposites: two numbers that are the same distance from zero on a number line.
- Absolute Value: the positive distance away from zero on a number line.
- Zero Pairs: opposite number values whose sum is zero.
- Additive Inverse: a number that when added to a given number gives zero.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students further their knowledge of the concepts of opposites, absolute value, and integer operations. Students learn rational number addition and subtraction. Students apply knowledge of rational number operations to write and solve one-step addition and subtraction equations. Rational number applications to real-world problem solving continue in all subsequent units to increase fluency throughout the school year.

Learning Tasks

Week One:

- Students learn to describe real world situations using integers.

Example:

. Determine if each statement is true or false.

a. A $100 check deposited in a bank can be represented by +100. ☐ True ☐ False

b. A loss of 15 yards in a football game can be represented by −15. ☐ True ☐ False

c. A temperature of 20 below zero can be represented by −20. ☐ True ☐ False

d. A submarine diving 300 feet below the surface can be represented by +300. ☐ True ☐ False

- Students learn to plot and describe points on number lines and the coordinate plane.

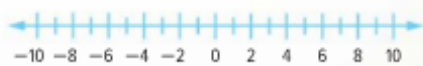
Examples:

Rachel recorded the overnight low temperatures for one week in a table.

Low Temperatures							
Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Temperature (°F)	2	−6	4	−8	2	0	−1

Plot a point on the number line for each recorded temperature.

What is the distance on the number line between the points that represent the warmest and coldest temperatures? ☐

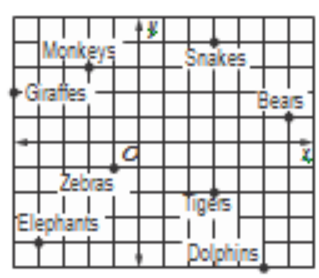


. **ZOOS** Use the map of the zoo at the right.

a. What animals are located at (−2, 3)?

b. In what quadrant are the bears located?

c. Find the ordered pair that represents the location of the dolphins.



- Students learn the concept and applications of absolute value.

Example:

Does $|-13 + 2|$ equal $|10 + 1|$? If so, explain why. If not, state what each absolute value equals. 7.NS.3

Challenge:

Determine whether each state is *always, sometimes,* or *never* true. Explain your reasoning.

a. $|x| = |-x|$

b. $|x| = -|x|$

c. $|-x| = -|x|$

Week Two:

- Students evaluate numeric expressions using the order of operations; students write and evaluate algebraic expressions by substituting values.

Numeric Expressions:

Without parentheses, $8 + 30 \div 2 + 4 = 27$. Rewrite the expression on the left-hand side of the equation with parentheses so that it equals 13; then rewrite it so that is equals 23.

Algebraic Expressions:

A website charges $0.99 to download a game, and a $12.49 membership fee. Write an expression that gives the total cost in dollars to download *g* games. Then find the cost of downloading 6 games.

Challenge:

Tell whether the statement below is *sometimes, always,* or *never* true. Justify your reasoning.
The expressions x - 3 and y - 3 represent the same value.

Week Three:

- Students learn to add integers by modeling with number lines and integer chips; the concept of zero pairs (opposites) is used.

Example:

Select all of the scenarios or expressions that have a value of 0. 7.NS.1, 7.NS.1a, 7.NS.1b

- ☐ The temperature outside was –12 degrees Fahrenheit. The temperature increased 12 degrees. What is the temperature now?
- ☐ 8 + (–8)
- ☐ –5 + (–5)
- ☐ The diver was swimming at –20 feet. He came up 20 feet. What is the diver's elevation now?
- ☐ A company had a net profit of –$2,000 last year. This year, the company has a net profit of $2,000. How much did the company's net profit increase this year from last year?

➢ Simplify each expression. Sort each expression into the correct category by writing the letter of the card in the box.

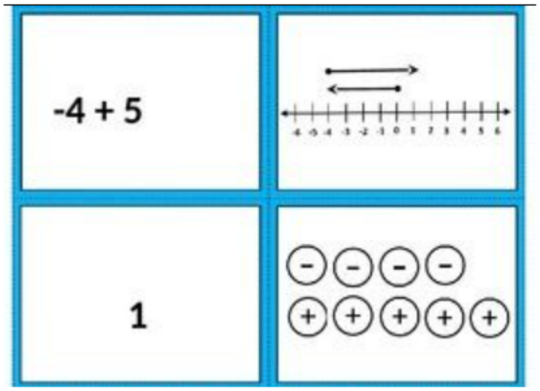
Card A	***Card B***	***Card C***
-4 + (-1)	13 + (-7) -1	-8 + |-8| + 5
Card D	***Card E***	***Card F***
|2| + (-7)	|11| + (-6)	1 – 4 + (-2)

Value equals the opposite of 5	Value equals the opposite of -5

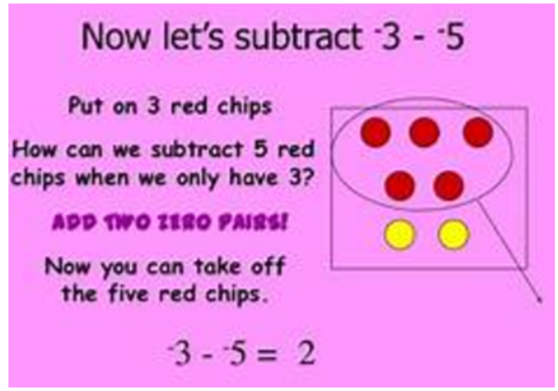
Week Four:

- Students learn to subtract integers by modeling with number lines and integer chips; students recognize that every subtraction problem can be rewritten by adding the opposite value.

Addition Model:



Subtraction Model:



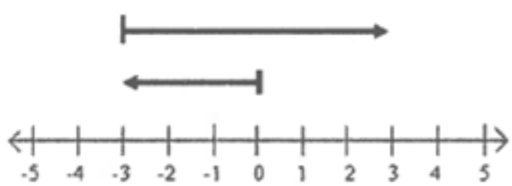
Examples:

➢ Circle an expression that is equivalent to the expression in the first column. The first one is done for you.

-3 - 1	-3 + 1	-3 + (-1)	-3 - (-1)
-2 - 9	-2 - (-9)	-2 + 9	-2 + (-9)
-8 - 4	-8 + 4	-8 + (-4)	-8 - (-4)
6 - (-2)	6 + 2	6 - 2	6 + (-2)
5 - (-7)	5 - 7	5 + (-7)	5 + 7
-1 - (-3)	-1 - 3	-1 + 3	-1 + (-3)
-3 - (-8)	-3 + 8	-3 - 8	-3 + (-8)

➢ Which equation is modeled on the number line?

a) -3 + 3 = 6 b) -3 + 6 = 3 c) -3 + (-6) = 0 d) -3 – 6 = 3

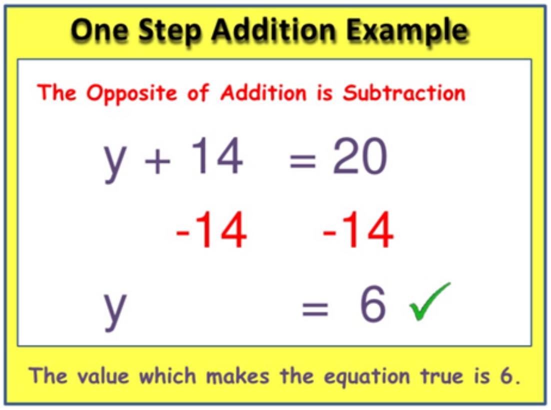


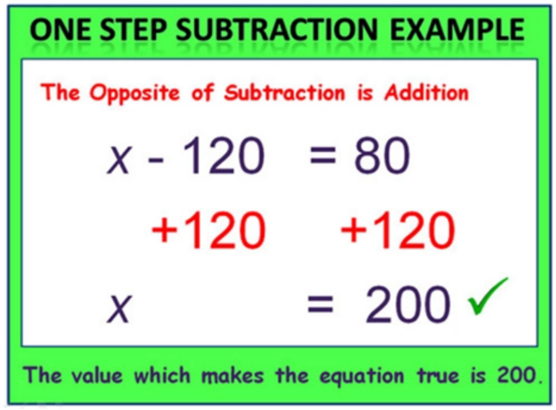
Challenge:

True or False? When *n* is a negative integer, *n* - *n* = 0. Justify your response.

Week Five:

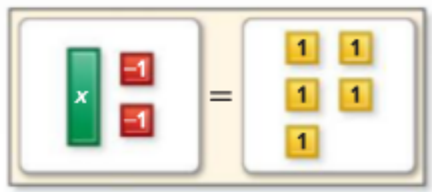
- Students model (using algebra tiles) and solve one-step integer equations involving addition and subtraction; problem solving applications.





Examples:

. The model represents the equation $x - 2 = 5$. Determine if each statement is true or false.

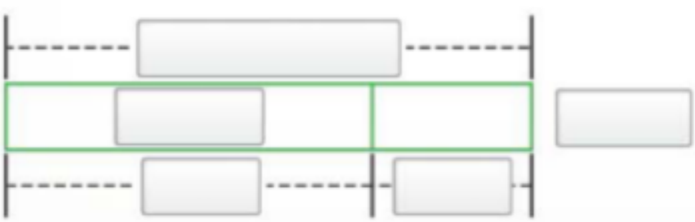


a. To solve the equation, add 2 positive counters to each side of the equation mat. ☐ True ☐ False

b. To solve the equation, add 5 negative to each side of the equation mat. ☐ True ☐ False

c. The value of x is 7. ☐ True ☐ False

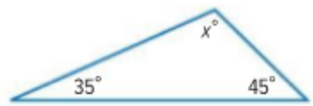
. Britney practiced the piano a total of 7 hours this week. This is 3 hours less than she practiced last week. Select the correct labels to complete the bar diagram that is used to find the number of hours w Britney practiced last week.



- this week
- last week, w
- 3 hours
- 4 hours
- 7 hours
- 10 hours

How many hours did Britney practice the piano last week? ______

The sum of the measures of the angles of a triangle is 180°.
Write and solve an equation to find the missing measure.



Challenge:
Suppose $x + y = 13$ and the value of x increases by 2. If the sum remains the same, what must happen to the value of y? Justify your response.

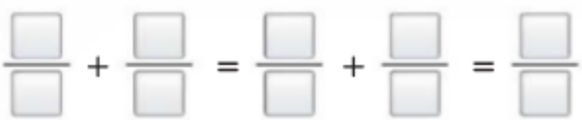
Week Six:

- Students add and subtract fractions and mixed numbers (with unlike denominators); skills are practiced individually with increasingly complex problems.

Examples:

The table shows the number of hours Orlando spent at football practice last week. Select the appropriate numbers below to complete the model to find the number of hours Orlando spent practicing on Tuesday and Friday.

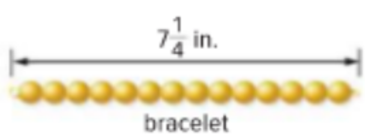
Day	Time (h)
Monday	$\frac{1}{2}$
Tuesday	$\frac{3}{4}$
Thursday	$\frac{1}{3}$
Friday	$\frac{5}{6}$



1	9
3	10
4	12
5	16
6	19

How many hours did Orlando spend practicing on Tuesday and Friday?

➢ Margarite made the jewelry shown. If the necklace is $\boxed{10\frac{5}{8}}$ in longer than the bracelet, how long is the necklace?



➢ The expression $\boxed{-5 + 1\frac{1}{8}}$ is equivalent to:

a) $\boxed{-4\frac{1}{8}}$ b) $\boxed{-3\frac{7}{8}}$ c) $\boxed{-3\frac{1}{8}}$ d) $\boxed{-6\frac{1}{8}}$

Week Seven:

- Students solve one-step rational number equations involving addition and subtraction using *properties of equality*; problem solving applications.

For word problems:

1. Define the variable.
2. Write the equation.
3. Solve, showing all steps.
4. Check/prove your solution.
5. Write a statement explaining the solution in the context of the question.

Week Eight:

- Students solve application problems involving rational numbers.

Examples:

➢ Write a numeric expression for the following situations and find the value. Explain what your answer means in the context of the question.

a) Michael had $400 in his bank account. He withdrew $350 for books, and $35 for a concert ticket. Then he received a check from his parents for $80, which he deposited. After all of these transactions, what is his new balance?

b) The height of Tom's house from ground level to the top of the roof is 23 feet. The basement floor of his house is 7 feet below the ground level. What is the distance in feet, between the top of the roof and the basement floor?

➢ Which of the following situations describes getting a temperature of 0º?

- The temperature starts at 10º and increases 10º.
- The temperature starts at 0º and then decreases 10º.
- The temperature starts at -10º and then decreases 10º.
- The temperature starts at -10º and then increases 10º.

➢ The absolute value of Dudley's account is $56. Select whether each situation gives that balance. You must prove your choice.

Yes	***No***	***Situation***
		The balance is $153 before he withdraws $103.
		Dudley's balance is -$42 before he deposits $98.

		The original balance is \$0. Dudley deposits \$18 and then withdraws \$74.

A company surveys its customers at several locations to see how well the employees are performing. The table shows the ratings. The manager at one location promises her employees a party if they end up with a positive score. Select the scenarios that would *not* result in the store getting a party. 7.EE.3

Response	Rating	Letter
Excellent	+1	A
Above average	+0.5	B
Average	0	C
Below average	–1	D
Poor	–2	F

- ☐ 13 Ds and 14 As
- ☐ 1 D, 10 Cs, and 3 Bs
- ☐ 4 As, 8 Bs, 1 C, 4 Ds, and 2 Fs
- ☐ 4 Fs and 9 Bs

Fernando, Andie, and Julio were tied for first place at math competition. The tie-breaker problem to determine the winner was to simplify the expression: $\frac{5}{8}-\frac{3}{4}-\frac{1}{6}+\frac{7}{12}$. The table shows the steps that each student took to solve the problem. 7.NS.1, 7.NS.1c, 7.NS.3

	Andie	Julio	Fernando
Step 1	$\left(\frac{5}{8}+\frac{7}{12}\right)+\left(-\frac{3}{4}-\frac{1}{6}\right)$	$\left(\frac{5}{8}+\frac{7}{12}\right)+\left(-\frac{3}{4}-\frac{1}{6}\right)$	$\left(\frac{5}{8}+\frac{7}{12}\right)+\left(-\frac{3}{4}-\frac{1}{6}\right)$
Step 2	$\left(\frac{15}{24}+\frac{14}{24}\right)+\left(-\frac{18}{24}-\frac{4}{24}\right)$	$\left(\frac{15}{24}+\frac{14}{24}\right)+\left(-\frac{18}{24}-\frac{4}{24}\right)$	$\frac{12}{20}-\frac{4}{10}$
Step 3	$\frac{29}{24}+\left(-\frac{22}{24}\right)$	$\frac{29}{24}-\frac{22}{24}$	$\frac{8}{10}$
Step 4	$\frac{51}{24}$	$\frac{7}{24}$	$\frac{4}{5}$

Part A: Who was the winner of the competition?

Part B: What errors did the other two students make?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 2: Rational Numbers: Multiplication and Division
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.NS.2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.

a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1) (–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then –(p/q) = (–p)/q = p/(–q). Interpret quotients of rational numbers by describing real-world contexts.
c. Apply properties of operations as strategies to multiply and divide rational numbers.

d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.

7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)

7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10percent raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be 305 used as a check on the exact computation.*

Supporting Standard:

7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5 percent" is the same as "multiply by 1.05."*

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: • Multiply and divide rational numbers.	*Students will know/understand:* • Integer rules for multiplication and division • Multiply/divide fractions and mixed numbers • Equivalent forms of rational numbers
• Understand that every quotient of integers with a non-zero divisor is a rational number.	• Terminating and repeating decimals
• Solve one step multiplication and	• Properties of Equality for multiplication

division equations using rational numbers with and without context.	and division • Multiply/divide rational numbers
• Write and solve one step multiplication and division equations using rational numbers to solve real world problems.	• Rational numbers in context • Solve one-step multiplication and division equations
• Solve multi-step real-world problems involving multiplying and dividing rational numbers.	• Rational numbers in context
• Understand equivalent forms of an expression.	• Equivalent forms of expressions • Distributive Property

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is the purpose of multiplying and dividing rational numbers?	1. Multiplying and dividing rational numbers can be applied to describe real world concepts like area, volume, recipes, or money and when evaluating expressions or solving equations.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can fluently calculate with rational numbers without the use of technology.

Informational Texts

Informational Books:
- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Integers, Operations with Integers, Rational Numbers, One Variable Equations

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Integers: whole numbers and their opposites.
- Rational numbers: real numbers that can be written as a fraction.
- Expression: a mathematical phrase that contains numbers and/or variables and operators.
- Equation: a mathematical statement in which two expressions are equal.
- Multiplicative Inverse: a quantity that when multiplied by another number gives one.
- Distributive Property: to multiply a sum by a number, multiply each addend of the sum by the number a(b+c) = ab + bc.
- Coefficient: numerical quantity multiplied by a variable in an algebraic expression.
- Constant: a quantity that does not change in value regardless of the value of a variable.
- Term: a single number, variable, or product or quotient and a variable.
- Like Terms: terms in an algebraic expression that contain the same variables and powers.

Learning Plan

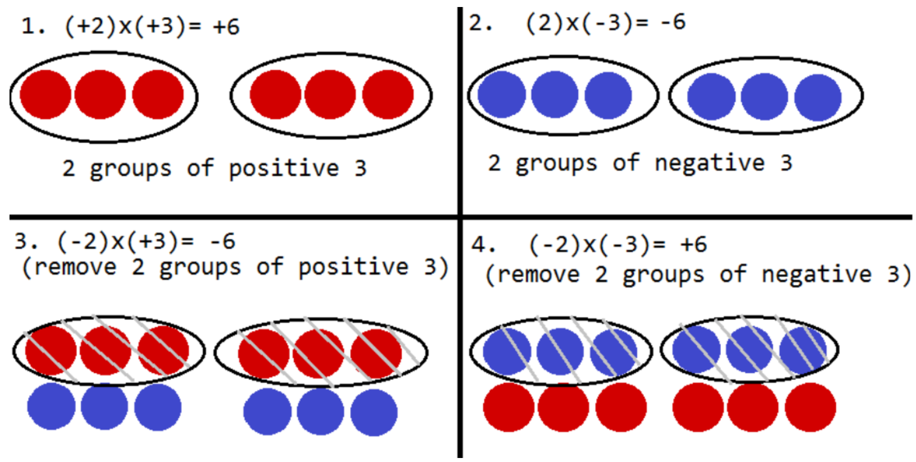
Overview and Key Learning Events and Instruction Per Week

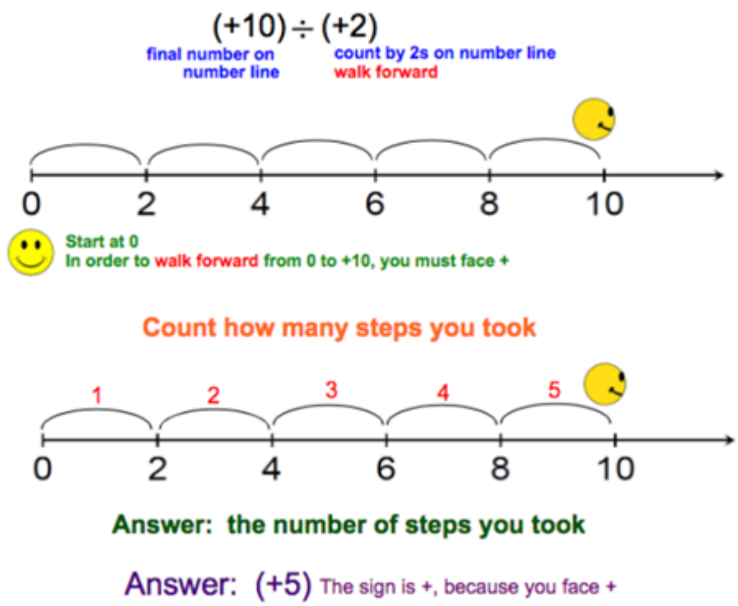
The standards in this unit are part of a *major content cluster*. Students further their knowledge of the concepts of rational numbers, opposites, absolute value, and integer operations. Students learn rational number multiplication and division. Students apply knowledge of rational number operations to write and solve one step multiplication and division equations. Rational number applications to real-world problem solving continue in all subsequent units to increase fluency throughout the school year.

Learning Tasks

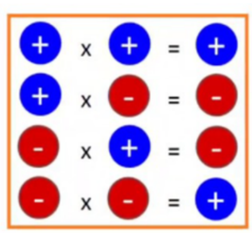
Week One:

- Students learn the rules for multiplying and dividing integers by modeling with number lines and integer chips.

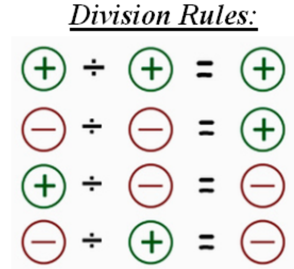




Multiplication Rules:

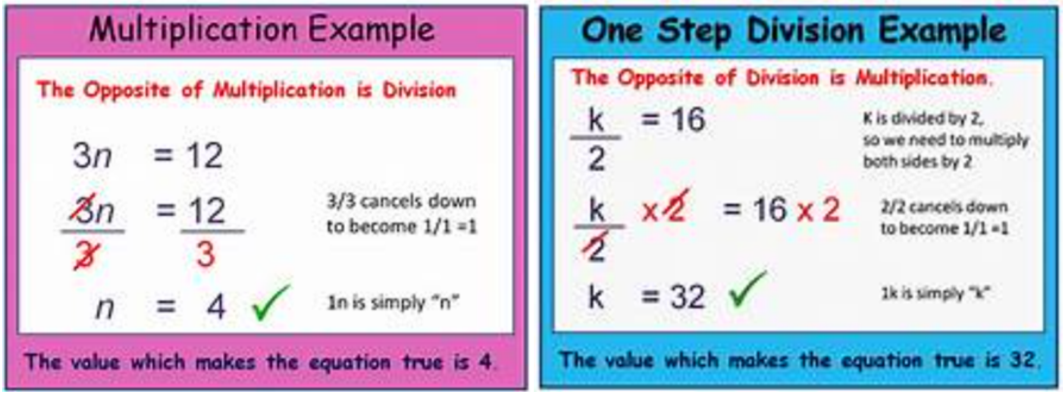


Division Rules:



Week Two:

- Students model (using algebra tiles) and solve one-step integer equations involving multiplication and division.



Week Three:

- Students multiply and divide fractions and mixed numbers; skills are practiced individually with increasingly complex problems.

Week Four:

- Students solve one-step rational number equations involving multiplication and division using *properties of equality*; problem solving applications.

For word problems:

1. Define the variable.
2. Write the equation.
3. Solve, showing all steps.
4. Check/prove your solution.
5. Write a statement explaining the solution in the context of the question.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

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☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 3: Equivalent Expressions
Pacing	Two Weeks

CT Core Standards   *What are the goals of this unit?*
Mathematical Practices: *(Practices in **bold** are to be emphasized in the unit.)*   1. Make sense of problems and persevere in solving them.   2. Reason abstractly and quantitatively.   **3. Construct viable arguments and critique the reasoning of others.**   4. Model with mathematics.   5. Use appropriate tools strategically.   **6. Attend to precision.**   **7. Look for and make use of structure**.   8. Look for and express regularity in repeated reasoning.   ***Priority/Focus Standard:***   7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. For example, $4x+2 = 2(2x +1)$ and $-3(x – 5/3) = -3x+5$.

Supporting Standard: 7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05." A shirt at a clothing store is on sale for 20% off the regular price, "p". The discount can be expressed as 0.2p. The new price for the shirt can be expressed as p – 0.2p or 0.8p.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: ● Identify coefficients, variables, constants, and like terms.	*Students will know/understand:* ● Coefficients ● Variables ● Constants ● Like terms
● Combine like terms including those with rational constants and rational coefficients.	● Coefficients ● Variables ● Constants ● Like terms ● Rational number operations
● Use properties of operations (including the distributive property) to expand linear expressions, including those containing rational numbers.	● Distributive property ● Rational number operations
● Rewrite an expression in different forms to recognize how the quantities are related.	● Equivalent expressions

Essential Questions *What essential questions will be considered?*	*Corresponding Big Ideas* *What understandings are desired?*
1. When are two expressions equivalent?	1. Equivalent expressions have the same value when the variable(s) is replaced by the same number(s).

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. • Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can identify equivalent expressions without the use of technology.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems) • Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions) ***Media:*** N/A ***Online Resources/Websites:*** • IXL Lessons- Grade 7 Mathematics, Expressions and Properties

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Coefficient- a numerical or constant quantity placed before and multiplying the variable in an algebraic expression.
- Variable- a symbol (usually a letter) that represents an unknown value in an algebraic expression or equation.
- Constant- a number whose value is fixed.
- Like Terms- terms that have the same variables and powers.
- Distributive Property: a(b+c) = ab+ac.
- Equivalent Expressions- expressions have the same value when the variable(s) is replaced by the same number(s).

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. This unit reinforces rational number operations by introducing the process of simplifying and expanding expressions. Throughout the course of this unit, students apply properties of operations as strategies to add, subtract, and expand linear expressions with rational coefficients. Students rewrite expressions in different forms in problem contexts to recognize how the quantities are related. Students will apply this understanding to solve equations and inequalities in future units.

Learning Tasks

Week One:

- Students model expressions using algebra tiles to learn to identify equivalent expressions involving the distributive property and combining like terms. Expressions contain rational number coefficients and constants.

Examples:

➢ For numbers 1a–1e, select Yes or No to indicate whether each of these expressions is equivalent to $2(2x + 1)$.

1a.	$4x + 2$	◯ Yes	◯ No
1b.	$2(1 + 2x)$	◯ Yes	◯ No
1c.	$2(2x) + 1$	◯ Yes	◯ No
1d.	$2x + 1 + 2x + 1$	◯ Yes	◯ No
1e.	$x + x + x + x + 1 + 1$	◯ Yes	◯ No

➢ Suzanne thinks the two expressions 2(5a – 2) and 10a – 2 are equivalent? Is she correct? Explain why or why not?

➢ Write equivalent expressions for 3a + 12.
Possible solutions might include factoring as in 3(a + 4), or other expressions such as a + 2a + 7 + 5.

➢ A rectangle is twice as long as wide. One way to write an expression to find the perimeter would be w + w + 2w + 2w. Write the expression in two other ways.

➢ An equilateral triangle has a perimeter of 6x + 15. What is the length of each of the sides of the triangle?

Week Two:

- Students relate quantities in an expression to describe how they are related. Students write equivalent expressions to represent the same situation.

Example:

➢ Jamie and Ted both get paid an equal hourly wage of $9 per hour. This week, Ted made an additional $27 dollars in overtime. Write an expression that represents the weekly wages of both if J = the number of hours that Jamie worked this week and T = the number of hours Ted worked this week? Can you write the expression in another way?

*Students may create several different expressions depending upon how they group the quantities in the problem. One student might say: To find the total wage, I would first multiply the number of hours Jamie worked by 9. Then I would multiply the number of hours Ted worked by 9. I would add these two values with the $27 overtime to find the total wages for the week. The student would write the expression 9J + 9T +27. Another student might say: To find the total wages, I would add the number of hours that Ted and Jamie worked. I would multiply the total number of hours worked by 9. I would then add the overtime to that value to get the total wages for the week. The student would write the expression 9(J + T) + 27. A third student might say: To find the total wages, I would need to figure out how much Jamie made and add that to how much Ted made for the week. To figure out Jamie's wages, I would multiply the number of hours she worked by 9. To figure out Ted's wages, I would multiply the number of hours he worked by 9 and then add the $27 he earned in overtime. My final step would be to add Jamie and Ted wages for the week to find their combined total wages. The student would write the expression (9J) + (9T + 27).

- ***Challenge:***

  Given a square pool as shown in the diagram below, write four different expressions to find the total number of tiles in the border. Explain how each of the expressions relates to the diagram and demonstrate that the expressions are equivalent. Which expression do you think is most useful? Explain your thinking.

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

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Effectively Communicating

☒ Creatively Thinking

☒ Persevering

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☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
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Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 4: Solving Equations and Inequalities
Pacing	Four Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.EE.4 Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.

a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where

p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* b. Solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solutions.* c. Extend analysis of patterns to include analyzing, extending, and determining an expression for simple arithmetic or geometric sequences (e.g., compounding, increasing area), using tables, graphs, words, and expressions. ***Supporting Standard:*** 7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Solve equations in the form px + q = r and p (x + q) = r, where p, q, and r are specific rational numbers.	*Students will know/understand:* ● Models with algebra tiles ● Two-step equations
● Solve real world problems by writing and solving equations.	● Equations in context
● Compare algebraic and arithmetic solutions by identifying the sequence of the operations used in each approach.	● Solution sets
● Solve inequalities of the form px + q > r or px + q < r, where p, q, and r are	● Two-step inequalities ● Solution sets

specific rational numbers. This includes ≤ and ≥.	
• Graph the solution set of the inequality.	• Solution sets • Number line graphs
• Solve real world problems by writing and solving inequalities.	• Inequalities in context
• Interpret a solution set with context of a real-world problem.	• Inequalities in context • Solution sets
• Recognize angle relationships, specifically supplementary, complementary, vertical, and adjacent angles.	• Complementary angles • Supplementary angles • Vertical angles • Adjacent angles
• Apply knowledge of angle relationships to write and solve simple equations for an unknown angle in a figure.	• Angle relationships in context

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are writing and solving equations and inequalities useful?	1. Writing and solving equations and inequalities can be applied to real world problem solving involving concepts such as money, time, measurement, and geometric relationships.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can solve equations and inequalities without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

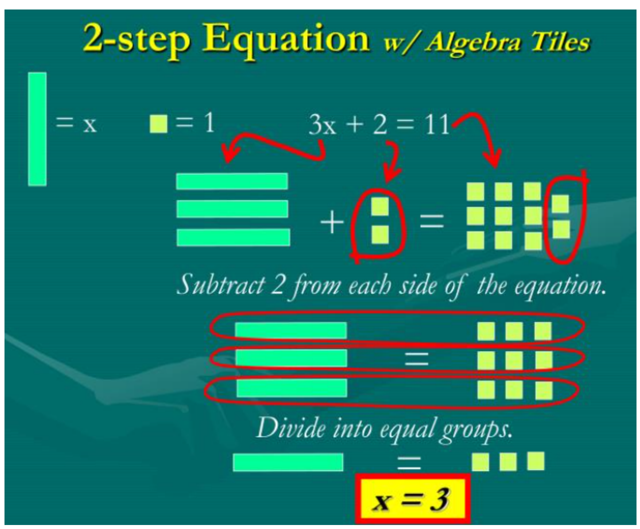
- IXL Lessons - Grade 7 Mathematics, One Variable Equations and One Variable Inequalities

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Equation: a statement of equivalence of two mathematical expressions.
- Inequality: a comparison of two values showing that one is value greater than or less than the other value.
- Solution: a value or set of values that satisfy an equation or inequality.
- Complementary angles: two angles with a sum of 90^{o}.
- Supplementary angles: two angles with a sum of 180^{o}.
- Vertical angles: pairs of opposite angles made by two intersecting lines.
- Adjacent angles: two angles that share a common vertex and common ray.

Learning Plan

Overview and Key Learning Events and Instruction Per Week
The standards in this unit are part of a *major content cluster*. Students use their prior knowledge of rational numbers and algebraic expressions to write and solve one- and two-variable equations in the context of real-world problems. Students learn to write and solve inequalities with rational numbers including ≥ and ≤. An emphasis is placed on problem solving to achieve fluency when solving equations. Students understand the relationships between angles formed by intersecting lines (supplementary, complementary, vertical, adjacent). Students solve real-world. mathematical problems involving angle measures.
Learning Tasks
Week One: ● Students model (with algebra tiles) and solve equations in the form px + q = r and p (x + q) = r, where p, q, and r are specific rational numbers.  ***<u>Challenge:</u>***

In the following equation, a and b are both integers.

$$a(3x - 8) = b - 18x$$

What is the value of a? ☐

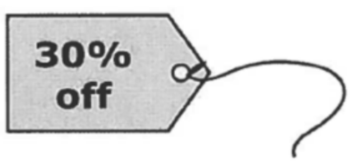
What is the value of b? ☐

Week Two:

- Students solve real world problems by writing and solving equations in the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers; students compare algebraic and arithmetic solutions. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? To solve algebraically: 2w + 2(6) = 54. To solve arithmetically: [54 – 2(6)] ÷ 2 is the width.*

Examples:

➢ All books in a store are discounted by 30%.



➔ Part A: Let x represent the regular price of any book in the store. Write an expression for the sale price of any book.

➔ Part B: The sale price of a book is \$5.60. Write and solve an equation to find the regular price of the book.

➢ The youth group is going on a trip to the state fair. The trip costs \$52. Included in that price is \$11 for a concert ticket and the cost of 2 passes, one for the rides and one for the game booths. Each of the passes cost the same price. Write an equation representing the cost of the trip and determine the price of one pass.

x	x	11
52		

$2x + 11 = 52$
$2x = 41$
$x = \$20.5$

Week Three:

- Students solve and graph the solution set of inequalities of the form px + q > r or px + q < r, where p, q, and r are specific rational numbers. This includes ≤ and ≥.

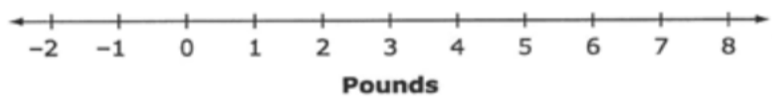
Example:

David wants to buy 2 pineapples and some bananas.

- The price of 1 pineapple is $2.99.
- The price of bananas is $0.67 per pound.

David wants to spend less than $10.00. Write an inequality that represents the number of pounds of bananas, *b*, David can buy.

On the number line below, draw a graph that represents the number of pounds of bananas David can buy.



Week Four:

- Students solve real world problems by writing and solving inequalities and interpret the solution set within the context of the situation.

  *Supporting standard: Students recognize angle relationships, specifically supplementary, complementary, vertical, and adjacent angles and apply knowledge of angle relationships to write and solve simple equations for an unknown angle in a figure.

Examples:

➢ Florencia has at most $60 to spend on clothes. She wants to buy a pair of jeans for $22 dollars and spend the rest on t-shirts. Each t-shirt costs $8. Write an inequality for the number of t-shirts she can purchase.

➢ Steven has $25 dollars. He spent $10.81, including tax, to buy a new DVD. He needs to set aside $10.00 to pay for his lunch next week. If peanuts cost $0.38 per package including tax, what is the maximum number of packages that Steven can buy? Write and solve an inequality.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving ☐ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 5: Applications of Ratios and Rates
Pacing	Three Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices: *(Practices in **bold** are to be emphasized in the unit.)* 1. Make sense of problems and persevere in solving them. **2. Reason abstractly and quantitatively.** 3. Construct viable arguments and critique the reasoning of others. **4. Model with mathematics.** **5. Use appropriate tools strategically.** 6. Attend to precision. **7. Look for and make use of structure.** 8. Look for and express regularity in repeated reasoning. ***Priority/Focus Standards:*** 7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each ¼ hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour,*

equivalently 2 miles per hour. 7.RP.2 Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate. ***Supporting Standard:*** 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Use various strategies to determine whether two quantities are proportional by constructing a ratio table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.	*Students will know/understand:* ● Proportional relationships ● Ratio tables ● Graphs of proportional relationships ● Unit rates ● Constant of proportionality
● Compute unit rates with ratios of fractions including ratios of lengths, areas, and other quantities measured in like or different units.	● Proportional relationships ● Unit rates

• Identify the unit rate (constant of proportionality) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.	• Proportional relationships • Unit rates • Constant of proportionality
• Write equations for proportional relationships using the unit rate. *For example: d = 65t.*	• Proportional relationships • Equations of proportional relationships
• Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the origin and (1, r) where r is the unit rate.	• Proportional Relationships • Graphs of proportional relationships

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. In what ways can you determine whether two quantities are proportional?	1. The graph of a proportional relationship is a line passing through the origin. The equation of a proportional relationship is in the form y=kx, where k is the unit rate, or constant of proportionality.
2. What does a point (x, y) on a line through the origin represent in context of the problem?	2. The ratio of y/x is the unit rate, or constant of proportionality in the problem.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Proportional Relationships

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Ratio Table- a table that shows equivalent ratios between two quantities.
- Unit Rate- the ratio of two different units, with denominator as 1; for example, kilometer/hour, meter/sec, or miles/hour.
- Constant of Proportionality- the constant value of the ratio between two proportional quantities.
- Proportional Relationship- a relationship in which two quantities vary directly with each other; y varies directly as x if: for some constant k, called the constant of proportionality, y=kx.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. In this unit, students will decide whether two quantities are proportional, and they will learn to analyze proportional relationships. They will also solve problems involving unit rates associated with ratios of fractions. While determining proportionality, the focus should be on the understanding of equivalent ratios. Students work with equations in the form y = mx, recognizing m as the unit rate, or constant of proportionality. In future units, students will use proportional relationships to solve problems with ratios and percent.

Learning Tasks

Week One:

- Students compute unit rates with ratios of fractions including ratios of lengths, areas, and other quantities measured in like or different units; *for example, if a person walks 1/2 mile in each ¼ hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.*

- Students identify the unit rate (constant of proportionality) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

To find the CONSTANT OF PROPORTIONALITY create a chart using points from the graph.

(2, 20), (4, 40), (6, 60), etc.

Divide the POUNDS by the PRICE to find the ratio:

Pounds x	Price y
2	20
4	40
6	60
8	80
10	100

RATIO: 1:10
Constant = 10
Equation: y =kx
y = 10x

Week Two:

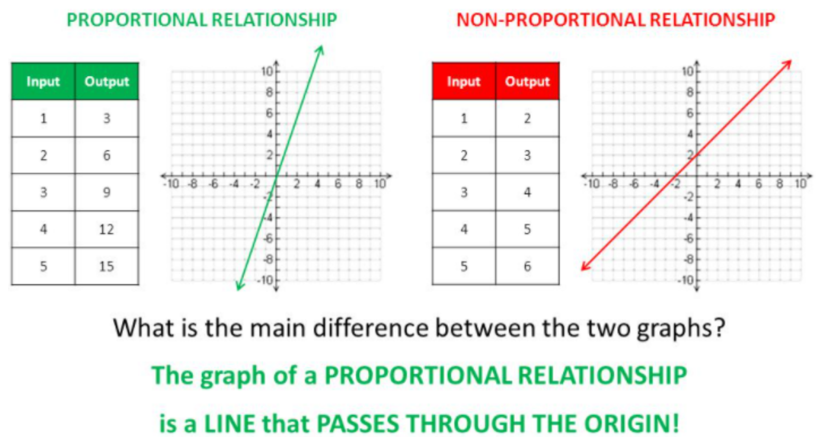
- Students use various strategies to determine whether two quantities are proportional by constructing a ratio table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

- ➢ Map the relationships of ratios and rates using diagrams, tables, graphs, or equations.

- ➢ Interpret mathematical results in the context of the situation.

- ➢ Use the unit rate (slope) to verify whether quantities are proportional.

- ➢ Plot points on a graph to check proportionality by verifying with a straight line through the origin.



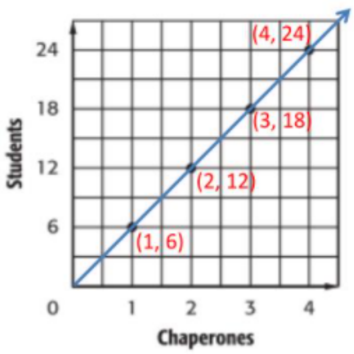
Week Three:

- Students write equations for proportional relationships using the unit rate. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.*

- Students explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the origin and (1, r) where r is the unit rate.

Writing an equation from the graph of a proportional relationship

Ex. 1) The number of students that can go on a trip is proportional to the number of chaperones that are available.



A) Find the constant of proportionality k, or the unit rate, of this relationship.

$$\frac{\text{students}}{\text{chaperones}} \qquad k = \frac{6\text{ students}}{1\text{ chaperone}}$$

$$\frac{6}{1} \qquad \frac{12}{2} = \frac{6}{1} \qquad \frac{18}{3} = \frac{6}{1} \qquad \frac{24}{4} = \frac{6}{1}$$

B) Write an equation to represent this relationship.

No. of students $y = kx$ No. of chaperones

$$\mathbf{y = 6x}$$

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The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☒ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 6: Application of Percents
Pacing	Five weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems.
Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Supporting Standard:

7.NS.A.3 Solve real-world and mathematical problems involving the four operations with rational numbers

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Convert between different forms of rational numbers (fractions decimals, and percents).	*Students will know/understand:* • Relationship between different forms of a rational number (fractions decimals, and percents)
• Utilize mental computation, estimation strategies, bar diagrams, proportions and equations to solve percent problems and assess the reasonableness of answers.	• Mental math • Estimation • Bar diagrams • Proportions • Percent equation (*part=percent x whole*)
• Solve multi-step percent problems involving mark-up and mark down, discounts, sales tax, gratuities, commissions, simple interest, percent increase and decrease, and percent error.	• Mark up/mark down • Discount • Sale price • Sales tax • Gratuities • Commission • Simple interest • Percent increase and decrease • Percent error

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What are real-life applications of percent?	1. Percent calculations can be applied to real world problems involving sales tax, gratuities, discounts, sale prices, commission, simple interest, percent increase, percent decrease, and percent error.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Percents, Consumer Math

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Percent: parts per 100.
- Simple Interest: interest paid on the original amount of a loan or account.
- Commission: fee paid for a service or work.
- Wholesale: goods sold in large quantities to retailers with the intent of the items being sold by a retailer to consumers.
- Percent Change: ratio that compares the change in a quantity to the original quantity.
- Percent Error: ratio that compares the amount of error or inaccuracy to the actual quantity.
- Sales Tax: additional amount charged when an item is purchased.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students extend their knowledge of

rational number applications to include the use of percentages in solving problems. Students analyze proportional relationships and use strategies to solve real world problems involving percent, including percent increase and decrease, markups and markdowns, tax, gratuities, commission, simple interest, and percent error.
Learning Tasks

Week One:

- Students review fraction, decimal and percent equivalence; students compare number values written in all three forms.

Examples:

1) Between which two percents is ⅝? Justify your answer.

   A. 59% and 60%   B. 60% and 61%

   C. 61% and 62%   D. 62% and 63%

2) Which value is larger: 8/25 or 35%? Justify your answer.

3) Order from least to greatest: 3/50, 2/25, 0.09, 7%. Justify your answer.

   Write a percent value that is between ⅙ and ⅕ Critically Problem Solving
   Effectively Communicating
   Creatively Thinking
   Persevering
   Socially Aware

4) Responsibly Making Decisions. Justify your answer.

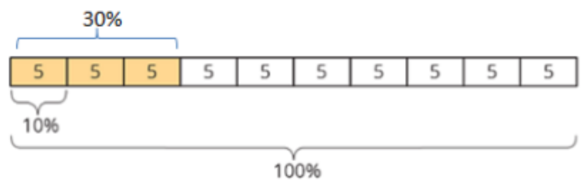
- Students solve percent of number problems for the part, whole and percent using various strategies, including mental math, bar diagrams, proportions, and equations.

Example:

Percentages and Tape Diagrams

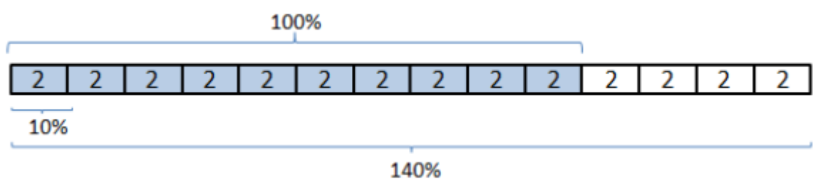
What is 30% of 50 pounds?

$50 \div 10 = 5$ Each part of the tape diagram. which represents 10%, is 5 pounds. 30% which is 3 parts is 15 pounds.



What is 100% of a number if 140% of it is 28?

$140 \div 10 = 14$ There are 14 parts in the tape diagram. Each part, which represents 10%, is 2 ($28 \div 14 = 2$). 100% which is 10 parts is 20.

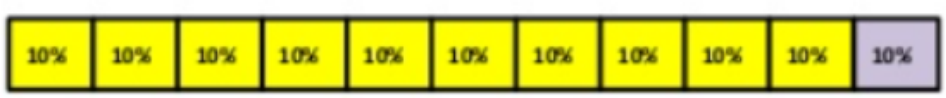


Week Two:

- Students solve real-world percent problems involving mark-up and mark down, discounts, sales tax, gratuities, commissions, and simple interest.

Example:

Anna owns a jewelry store. She has ordered a bracelet for $30 and plans on marking it up 10% to sell in the store. Find the price the bracelet will cost in the store after the 10% increase.



10% would mean using 100% ÷ 10 for the parts and each part representing 10%.

10% would mean using 1/10 and 30 ÷ 10 is 3 so each section represents $3.

The additional 10% would be an additional $3.00.

Anna's original cost of $30 plus the additional $3.00 would make the cost of the bracelet in the store $33.00.

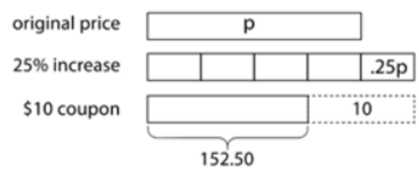
Week Three:

- Students solve percent change problems for the percent increase/decrease, the new value and the old value using various strategies, including mental math, bar diagrams, proportions and equations.

Example:

Percent Increase or Decrease

We can solve problems where there is a percent increase or decrease by using what we know about equations. For example, a camping store increases the price of a tent by 25%. A customer then uses a $10 coupon for the tent and pays $152.50. We can draw a diagram that shows first the 25% increase and then the $10 coupon.



The price after the 25% increase is p + .25p or 1.25p. An equation that represents the situation could be 1.25p – 10 = 152.50. To find the original price before the increase and discount, we can add 10 to each side and divide each side by 1.25, resulting in p = 130. The original price of the tent was $130.

$$1.25p - 10 = 152.50$$
$$1.25p = 162.50$$
$$p = 130$$

Week Four:

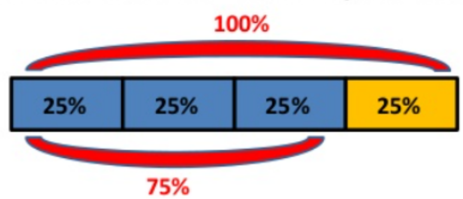
- Students solve real world percent problems involving percent change.

Example:

After a 25% discount, the price of a TV is $600. What was the price of the TV before the discount?

Hmmm...if you get 25% off......that means you are paying 75%...lets set up a tape diagram...

First we show what would be 100% in 4 parts because of the 25%



The 75% represents $600 and is shown to be 3 of the parts.
So $600 ÷ 3 = $200. That means each section (25%) represents $200
Which means your discount was $200 and that added onto the $600 makes the original price of the television $800.

Week Five:

- Students solve multi-step percent problems using various strategies, including mental math, bar diagrams, proportions and equations; use small group pairings of students, small group instruction/re-teaching of strategies, or independent practice.

Examples for Differentiation:

<u>Level 1 Problems (for ***all*** students):</u>

1) Find the result of a 30% increase if you start with $150.
2) Last year, there were 915 students at Franklin Middle School. This year the enrollment dropped by 20%. How many students go to Franklin Middle School this year?
3) A pair of jeans originally priced at $50.00 is first marked down 20% and then marked back up 20%. Find the final selling price of the jeans.
4) Skis at a sports store near Snow Summit are on sale for $476. If the original price was $560, what was the percent discount the store was offering?
5) The staff at a company increased from 32 employees to 40 employees. What is the percent increase in staff?

<u>Level 2 Reasoning Problems (for ***all*** students):</u>

1) <u>Explain</u> why is it possible to have a 150% increase, but not a 150% decrease?
2) Describe a simple way of explaining a 100% increase. Give an example to support your reasoning.
3) Can 50% more than one number be less than 1% more than another number? Give an example to support your answer.
4) Greg found the percent decrease from 120 to 100 using this reasoning: The percent increase from 100 to 120 is 20%, so the percent decrease from 120 to 100 is 20%. Is he correct? <u>Explain</u>.
5) Ellen needs to raise the price of a $10 item and lower the price of a $15 item so they are equal. She can only enter percent increases and percent decreases in the pricing computer. <u>Explain</u> how she can do this.

<u>Level 3 Challenge Problems (for ***accelerated*** learners):</u>

1) After a 40% discount, the sale price is $96. Find the original price.
2) After a 25% increase, the selling price of a TV was $750. Find the original cost.
3) If you add 50% of a number to itself, what percent of the result do you have to subtract to

get back to the original number? Explain/show your work.

4) A store has all board games on sale for 25% off the regular price. A checker set has a ***sale price*** of $12. The checker board set is moved to a clearance table where every item is discounted 40% off its ***regular price***. What is the ***clearance price*** of the checker board set?

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☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

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Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 7: Theoretical and Experimental Probability
Pacing	Three Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.SP.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is not unlikely or likely, and a probability near 1 indicates a likely event.

7.SP.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

Supporting Standards:

7.SP.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*

7.SP.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

a. Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.*
b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes of the penny appear to be equally likely based on the observed frequencies?*

Unwrapped Priority Standards	
Skills/Suggested Outcomes	***Concepts***

*What must students **do**?*	*What must students **know**?*
Students will be able to: ● Understand that the probability of a chance event is a number between 0 and 1; express probabilities as fractions, decimals, and percents.	*Students will know/understand:* ● Probability of simple events ● Probability of compound events ● Experimental vs theoretical probabilities
● Calculate the relative frequency of the event.	● Relative frequency
● Approximate the probability of a chance event by collecting data.	● Experimental probability
● Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation; understand that the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.	● Probability of compound events ● Organized lists ● Tree diagrams ● Simulations
● Represent sample spaces for compound events using methods such as organized lists, tables, and tree diagrams.	● Sample space ● Organized lists ● Tree diagrams
● Design and use a simulation to generate frequencies for compound events.	● Simulations

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What is probability, and how can it be used to describe the likelihood of an event?	1. Probability expresses the likelihood of the event occurring represented as a number from 0-1. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event. A probability around 1/2

	indicates an event that is neither unlikely or likely.
2. What is the difference between experimental and theoretical probability, and how can these ideas be used to make predictions?	2. Theoretical probability is what is expected to happen. Experimental probability is what actually happens in a trial. As more trials are conducted, the experimental probability generally gets closer to the theoretical probability.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Probability

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Theoretical probability - How likely an event is to occur represented by a number from 0-1, found by the number of favorable outcomes divided by the total number of possible outcomes.
- Experimental probability - the ratio of the number of times an event occurs to the total number of trials or times the activity is performed.
- Relative frequency - the ratio of the frequency of a particular event in a statistical experiment to the total frequency.
- Simple event - A single event.
- Compound event - consists of two or more events.
- Sample Space - the set of all possible outcomes of that experiment
- Probability model - is a mathematical representation of a random phenomenon. It is defined by its sample space, events within the sample space, and probabilities associated with each event.
- Simulation - a way of collecting probability data using actual objects, such as coins, spinners, and cards.

Learning Plan

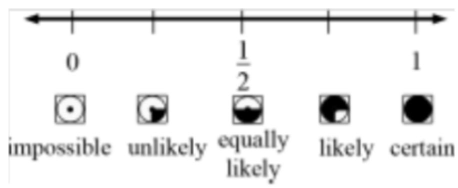
Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *supporting content cluster*. Students understand that the probability of a chance event is a number between 0 and 1 (written as a fraction, decimal or percent value) that expresses the likelihood of the event occurring. They collect data on a chance event and predict its relative frequency. Students develop a probability model and use it to find the probability of an event. They compare theoretical and experimental probabilities. Students find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

Learning Tasks

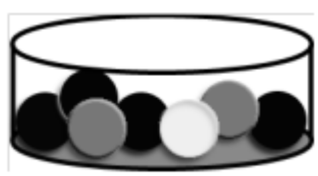
Week One:

- Students understand that the probability of a chance event is a number between 0 and 1, and express probabilities as fractions, decimals, and percents.



Example:

The container below contains 2 gray, 1 white, and 4 black marbles. Without looking, if you choose a marble from the container, will the probability be closer to 0 or to 1 that you will select a white marble? A gray marble? A black marble? Justify each of your predictions.



Week Two:

- Students approximate the probability of a chance event by collecting data and then compare experimental and theoretical probabilities of an event.

- Students calculate the relative frequency of the event.

Experimental vs. Theoretical Probability

When asked about the probability of a coin landing on heads, you would

probably answer that the chance is ½ or 50%.

Imagine that you toss that same coin 20 times. How many times would you expect it to land on heads? You might say, 50% of the time, or half of the 20 times. So, you would expect it to land on heads 10 times. This is the theoretical probability.

The theoretical probability is what you expect to happen, but it isn't always what happens. The table below shows the results after Sunil tossed the coin 20 times.

Outcomes	Frequency
Heads	13
Tails	7
Total	20

This shows the experimental probability. You can think of it as the probability determined from the results of an experiment. It is what actually happens instead of what you were expecting to happen.

The experimental probability of landing on heads is $\frac{13}{20} = \frac{65}{100} = 0.65 = 65\%$.

It landed on heads more times than we expected.

Now, Sunil continues to toss the same coin for 50 total tosses. The results are shown below.

Outcomes	Frequency
Heads	26
Tails	24
Total	50

Now the experimental probability of landing on heads is

$$\frac{26}{50} = \frac{52}{100} = 0.52 = 52\%$$

Outcome	Frequency
1	16
2	20
3	22
4	10
5	18
6	14
Total	**100**

a. Rolling a 3 (use the table)

$$\frac{22}{100} = 0.22 = 22\%$$

b. What is the theoretical probability of rolling a 3?

$$\frac{1}{6} = 0.166666... \approx 17\%$$

c. Rolling a number less than 3 (use the table)

(Rolling a 1 or 2) $\frac{36}{100} = 0.36 = 36\%$

d. Rolling a 3 or a 5 (use the table)

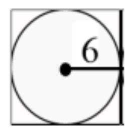
$$\frac{40}{100} = 0.40 = 40\%$$

*Students need multiple opportunities to perform probability experiments and compare these results to theoretical probabilities. Critical components of the experiment process are making predictions about the outcomes by applying the principles of theoretical probability, comparing the predictions to the outcomes of the experiments, and replicating the experiment to compare results. Experiments can be replicated by the same group or by compiling class data. Experiments can be conducted using various random generation devices including, but not limited to, bag pulls, spinners, number cubes, coin toss, and colored chips. As a challenge, students can also develop models for geometric probability (i.e., a target).

Example:

➢ Each group receives a bag that contains 4 green marbles, 6 red marbles, and 10 blue marbles. Each group performs 50 pulls, recording the color of marble drawn and replacing the marble into the bag before the next draw. Students compile their data as a group and then as a class. They summarize their data as experimental probabilities and make conjectures about theoretical probabilities (How many green draws would you expect if you were to conduct 1000 pulls? 10,000 pulls?). Students create another scenario with a different ratio of marbles in the bag and make a conjecture about the outcome of 50 marble pulls with replacement. An example would be 3 green marbles, 6 blue marbles, and 3 blue marbles. Students try the experiment and compare their predictions to the experimental outcomes to continue to explore and refine conjectures about theoretical probability.

➔ ***<u>Challenge:</u>*** If you choose a point in the square, what is the probability that it is not in the circle?



Week Three:

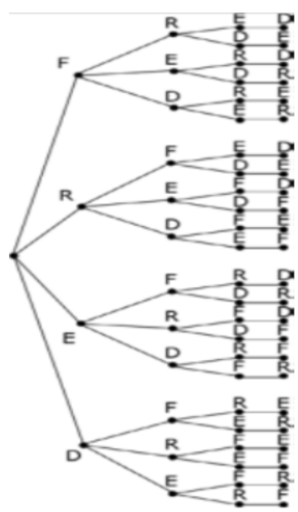
- Students represent the sample space and identify the outcomes in the sample space that compose the compound event.
- Students find the probabilities of compound events using organized lists, tables, tree diagrams, and simulations.
- Students understand that the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
- Students design and use a simulation to generate frequencies for compound events.

Examples:

1) Students conduct a bag pull experiment. A bag contains 5 marbles. There is one red marble, two blue marbles and two purple marbles. Students draw one marble without replacement and then draw another. What is the sample space for this situation? Explain how you determined the sample space and how you will use it to find the probability of drawing one blue marble followed by another blue marble.

➔ ***Challenge:*** Determine whether the events are independent or dependent based on whether the experiment is done with or without replacement. Repeat the experiment both ways.

2) Show all possible arrangements of the letters in the word FRED using a tree diagram. If each of the letters is on a tile and drawn at random, what is the probability that you will draw the letters F-R-E-D in that order? What is the probability that your "word" will have an F as the first letter?



Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by…
☒ Critically Problem Solving
☐ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 8: Sampling and Statistics
Pacing	Two Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in ***bold*** *are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

7.SP.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

7.SP.2 Use data from a random sample to draw inferences about a population with an unknown

characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.

Draw informal comparative inferences about two populations.

Supporting Standards:

7.SP.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team and both distributions have similar variability (mean absolute deviation) of about 5 cm. The difference between the mean heights of the two teams (10 cm) is about twice the variability (5cm) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.

7.SP.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth- grade science book.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Understand that validity depends on the sample being representative of the population.	*Students will know/understand:* • Random sample • Population

• Use a random sample to gain statistical information and draw inferences about a population.	• Random sample • Inferences
• Generate multiple samples of the same size to assess the variation (spread of data) in estimates or predictions. *For example, predict the winner of a school election based on randomly sampled survey data.*	• Random sample • Variation
• Compare two data distributions of similar variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team.*	• Mean absolute deviation
• Use measures of center and measures of variability (mean absolute deviation) to draw informal comparisons about two populations.	• Measures of center (mean, median, mode, range) • Measures of variability (mean absolute deviation)

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How can samples be used to make inferences about a population?	1. The larger the sample, the stronger the inference about the population and the smaller the sample, the weaker the inference about the population.
2. How can data displays, measures of center and measures of variability from random samples be used to draw informal comparative inferences about two populations?	3. Mean and median can easily be examined. The variability between the two data sets can also be compared.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons- Grade 7 Mathematics, Data & Graphs and Statistics

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Sample- a small part or quantity intended to represent the whole.
- Random Sample- a subset of a statistical population in which each member of the subset has an equal probability of being chosen. A simple random sample is meant to be an unbiased representation of a group.
- Population- is a whole, it's every member of a group.

- Mean- the average of a data set.
- Median- the middle of the set of numbers.
- Variability (mean absolute deviation) - the average distance between each data point and the mean.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards about using random sampling to draw inferences about a population (7. SP.1 and 7.SP.2) are part of a *supporting cluster*. The standards about drawing informal comparative inferences about two populations (7. SP.3 and 7.SP.4) are part of an *additional cluster*. Students

compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

Learning Tasks

Week One:

- Students understand that validity depends on the sample being representative of the population, and then use a random sample to gain statistical information and draw inferences about a population.

Examples:

1) The school food service wants to increase the number of students who eat hot lunch in the cafeteria. The student council has been asked to conduct a survey of the student body to determine the students' preferences for hot lunch. They have determined two ways to do the survey. The two methods are listed below. Identify the type of sampling used in each survey option. Which survey option should the student council use and why?

a) Write all the students' names on cards and pull them out in a draw to determine who will complete the survey.

OR

b) Survey the first 20 students that enter the lunchroom.

2) Below is the data collected from two random samples of 100 students regarding student's school lunch preferences. Make at least two inferences based on the results.

Lunch Preferences

student sample	hamburgers	tacos	pizza	total
#1	12	14	74	100
#2	12	11	77	100

Week Two:

- Students use measures of center and measures of variability (mean absolute deviation) to draw informal comparisons about two populations.

Example:

Jason wanted to compare the mean height of the players on his favorite basketball and soccer teams. He thinks the mean height of the players on the basketball team will be greater but doesn't know how much greater. He also wonders if the variability of heights of the athletes is related to the sport they play. He thinks that there will be a greater variability in the heights of soccer players as compared to basketball players. He used the rosters and player statistics from the team websites to generate the following lists.

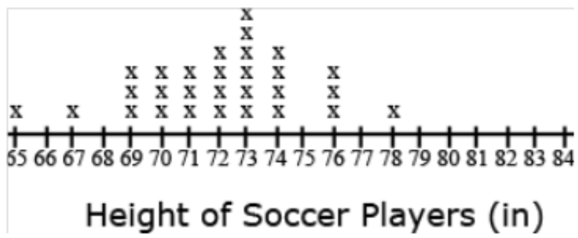
Basketball Team – Height of Players in inches for 2010-2011 Season

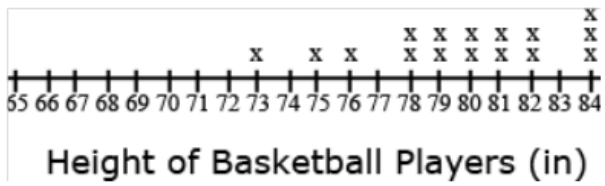
75, 73, 76, 78, 79, 78, 79, 81, 80, 82, 81, 84, 82, 84, 80, 84

Soccer Team – Height of Players in inches for 2010

73, 73, 73, 72, 69, 76, 72, 73, 74, 70, 65, 71, 74, 76, 70, 72, 71, 74, 71, 74, 73, 67, 70, 72, 69, 78, 73, 76, 69

To compare the data sets, Jason creates a two-dot plot on the same scale. The shortest player is 65 inches, and the tallest players are 84 inches.





In looking at the distribution of the data, Jason observes that there is some overlap between the two data sets. Some players on both teams have players between 73 and 78 inches tall. Jason decides to use the mean and mean absolute deviation to compare the data sets. Jason sets up a table for each data set to help him with the calculations.

The mean height of the basketball players is 79.75 inches as compared to the mean height of the soccer players at 72.07 inches, a difference of 7.68 inches.

The mean absolute deviation (MAD) is calculated by taking the mean of the absolute deviations for each data point. The difference between each data point and the mean is recorded in the second column of the table. Jason used rounded values (80 inches for the mean height of basketball players and 72 inches for the mean height of soccer players) to find the differences. The absolute deviation, absolute value of the deviation, is recorded in the third column. The absolute deviations are summed and divided by the number of data points in the set.

The mean absolute deviation is 2.14 inches for the basketball players and 2.53 for the soccer players. These values indicate moderate variation in both data sets. There is slightly more variability in the height of the soccer players. The difference between the heights of the teams is approximately 3 times the variability of the data sets ($7.68 \div 2.53 = 3.04$).

Soccer Players (n = 29)		
Height (in)	Deviation from Mean (in)	Absolute Deviation (in)
65	-7	7
67	-5	5
69	-3	3
69	-3	3
69	-3	3
70	-2	2
70	-2	2
70	-2	2
71	-1	1
71	-1	1
71	-1	1
72	0	0
72	0	0
72	0	0
72	0	0
73	+1	1
73	+1	1
73	+1	1
73	+1	1
73	+1	1
73	+1	1
74	+2	2
74	+2	2
74	+2	2
74	+2	2
76	+4	4
76	+4	4
76	+4	4
78	+6	6
Σ = 2090		Σ = 62

Mean = 2090 ÷ 29 =72 inches
MAD = 62 ÷ 29 = 2.13 inches

Basketball Players (n = 16)		
Height (in)	Deviation from Mean (in)	Absolute Deviation (in)
73	-7	7
75	-5	5
76	-4	4
78	-2	2
78	-2	2
79	-1	1
79	-1	1
80	0	0
80	0	0
81	1	1
81	1	1
82	2	2
82	2	2
84	4	4
84	4	4
84	4	4
Σ = 1276		Σ = 40

Mean = 1276 ÷ 16 =80 inches
MAD = 40 ÷ 16 = 2.5 inches

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☒ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when Applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 9: Circumference of Circles; Area of Polygons and Circles
Pacing	Two Weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices: *(Practices in **bold** are to be emphasized in the unit.)* **1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** 3. Construct viable arguments and critique the reasoning of others. **4. Model with mathematics.** **5. Use appropriate tools strategically.** 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. ***Priority/Focus Standard:*** 7.G.B.4 Know the formulas for the area and circumference of a circle and solve problems.

Supporting Standard: 7.G.B.6 Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Calculate the area of two-dimensional polygons including composite figures.	*Students will know/understand:* ● Polygons ● Composite figures ● Area formulas for two dimensional polygons (triangles, rectangles, parallelograms, and trapezoids)
● Solve conceptual and real-world problems involving areas of polygons.	● Polygons in context
● Understand that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle.	● Circles ● Radius ● Diameter ● Pi
● Describe the relationships among the radius, diameter, and circumference of a circle.	● Radius ● Diameter ● Pi
● Calculate the area and circumference of a circle using the formulas.	● Circumference formula ● Area formula of a circle
● Solve real-world problems involving area and circumference of circles.	● Circles in context

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is calculating the area of polygons including composite figures useful?	1. Calculating the area of polygons and composite figures can be applied to real world problem solving involving concepts such measurement and geometric relationships like carpeting a room, buying paint to paint a wall, or planting a garden including non-regular shapes.
2. How is calculating the circumference and area of circles useful?	2. Calculating the circumference and area of circles can be applied to real world problem solving involving concepts such measurement and geometric relationships like fencing in a circular space, planting a circular garden, or designing a circular sign.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)

- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons - Grade 7 Mathematics, Geometric Measurement

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Polygon: two-dimensional figure with at least three straight sides and angles.
- Composite figure: two-dimensional figure that consists of basic two-dimensional shapes.
- Parallelogram: four-sided plane figure with two sets of opposite sides that are parallel and congruent.
- Trapezoid: quadrilateral with only one set of parallel sides.
- Circle: two-dimensional closed figure in which all points are equidistant from the center.
- Radius: line segment from the center of a circle to the circumference.
- Diameter: line segment that passes through the center of a circle with endpoints on the circumference of the circle.
- Pi: the ratio of the circumference of a circle to its diameter.
- Circumference: the distance around a circle.

Learning Plan

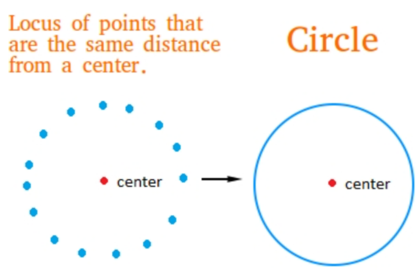
Overview and Key Learning Events and Instruction Per Week

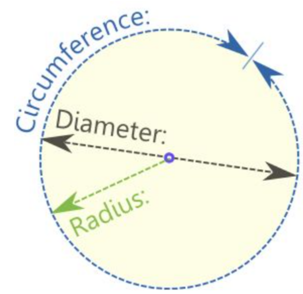
The standards in this unit are part of an *additional content cluster*. Students learn to calculate the areas of various polygons, including composite figures. An emphasis is on understanding, learning, and applying the formulas to find the circumference and area of circles. Students apply the formulas of circumference and areas of polygons and circles to solve real world problems. In future units, students will extend their knowledge of area to calculate surface area and volume of cubes and right prisms.

Learning Tasks

Week One:

- Students understand that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle; students are able to describe the relationships among the radius, diameter, and circumference of a circle.





- Students calculate the area and circumference of a circle using the formulas, and students solve real-world problems involving area and circumference of circles.

Formulas:

$$C = \pi \cdot d$$

$$A = \pi \cdot r^2$$

Examples:

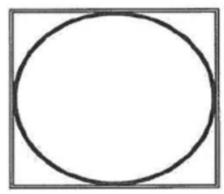
➔ Basil saw a strange old bicycle at the museum. It had one very big wheel and one very small one. It was called an "Ordinary" or a "Penny Farthing." At home Basil looked it up on the internet and found that the big wheel could have a 52-inch diameter and the small wheel could have an 18-inch diameter.

1) What is the circumference of the big wheel? Give your answer in inches.
2) How far would you travel in one turn of the big wheel? Give your answer in feet and inches?
3) How many times must the cyclist turn the big wheel to travel 1 mile? A mile is 1760 yards. Give your answer to the nearest 10 turns.

4) How many times does the small wheel turn when the cycle travels 1 mile?

➔ ***Challenge:***

An artist used silver wire to make a square that has a perimeter of 40 inches. She then used copper wire to make the largest circle that could fit in the square, as shown below.



How many more inches of silver wire did the artist use compared to copper wire? (Use $\pi = 3.14$) Show all work necessary to justify your response.

Week Two:

- Students calculate the area of two-dimensional polygons including composite figures, and then solve conceptual and real-world problems involving areas of polygons. Students' understanding of volume can be supported by focusing on the area of base times the height to calculate volume. Students' understanding of surface area can be supported by focusing on the sum of the area of the faces. Nets can be used to evaluate surface area calculations.

Examples:

1) Choose one of the figures shown below and write a step-by-step procedure for determining the area. Find another person that chose the same figure as you did. How are your procedures the same and different? Do they yield the same result?

2) Find the area of a triangle with a base length of three units and a height of four units.
3) Find the area of the trapezoid shown below using the formulas for rectangles and triangles.

Westbrook Public Schools' Portrait of a Graduate **Learning Expectations**
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☐ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 10: Surface Area; Volume; Slicing Solids
Pacing	Three Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standard:

7.G.B.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Supporting Standard:

7.G.A.3 Describe the shape of the two-dimensional face of the figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Solve real-world and mathematical problems involving area and surface area of figures composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	*Students will know/understand:* ● Area of a parallelogram, quadrilateral, square, rectangle, rhombus, trapezoid ● Two-dimensional vs. three dimensional figures ● Prism vs. pyramid ● Surface area in context
● Solve real-world and mathematical problems involving volume of right rectangular and triangular prisms.	● Volume of right rectangular prism ● Volume of right triangular prism
● Describe the two-dimensional figures that result from slicing right rectangular prisms and pyramids.	● Cross-sections

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How is calculating the surface area and volume of three-dimensional figures useful?	1. Calculating the surface area and volume of three-dimensional figures can be applied to real world problem solving involving concepts such measurement

	and geometric relationships like building a box, painting a room, or filling a pool.
2. How are the two-dimensional shapes that result from slicing a prism or pyramid determined?	2. The shape of the cross sections depends on whether the cut is parallel, perpendicular, or at an angle to the base.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

2. Communication and collaboration:

Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

4. Critical thinking, problem solving, and decision making:

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: Calculator; *recommended online calculator: desmos scientific*

Online Resources/Websites:

- IXL Lessons - Grade 7 Mathematics, Three-Dimensional Figures and Geometric Measurement

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

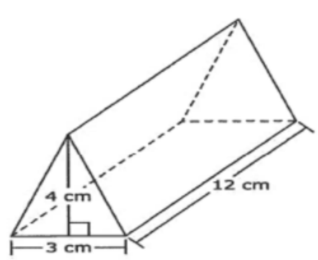
- Quadrilateral: two-dimensional four-sided figure.
- Parallelogram: quadrilateral with two sets of opposite sides that at parallel and congruent.
- Rectangle: quadrilateral with two sets of parallel sides and four right angles.
- Square: quadrilateral with four congruent sides and four right angles.
- Rhombus: parallelogram with opposite, congruent angles.
- Trapezoid: quadrilateral with only one set of parallel sides.
- Two-dimensional figure: figure that lies on one plane.
- Three-dimensional figure: figure with length, width, and height such as prisms and pyramids.
- Prism: three-dimensional figure with opposite, congruent bases.
- Pyramid: three-dimensional figure with a polygon as a base and triangular sides that meet at a point.
- Volume: three-dimensional space occupied by a figure.
- Surface area: sum of the area of the faces of a three-dimensional object.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of an *additional content cluster*. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections and nets. Students solve real-world and mathematical problems involving surface area and volume of three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Learning Tasks

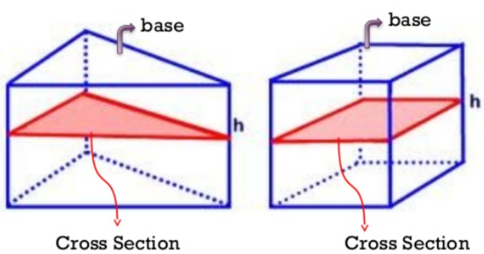
Week One: ● Students solve real-world and mathematical problems involving area and surface area of figures composed of triangles, quadrilaterals, polygons, cubes, and right prisms. ***Examples:*** ➢ The seventh-grade class is building a mini golf game for the school carnival. At the end of the 20-foot-long rectangular putting green there will be a semicircle. If the semi-circle is 10 feet in diameter, how many square feet of grass carpet will they need to buy to cover the entire putting green? Hint: Draw a diagram to help you. ➢ Students measure the circumference and diameter of several circular objects in the room (clock, trash can, doorknob, wheel, etc.). Students organize their information and discover the relationship between circumference and diameter by noticing the pattern in the ratio of the measures. Students write an expression that could be used to find the circumference of a circle with any diameter and check their expression on other circles.
Week Two: ● Students solve real-world and mathematical problems involving volume of right rectangular and triangular prisms. ***Examples:*** ➢ Find the volume (in cubic cm) of the triangular prism: 

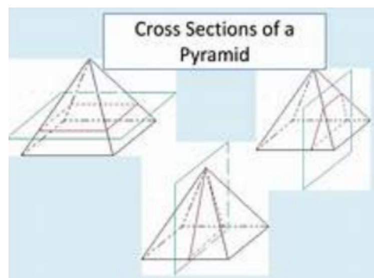
➢ A cereal box is a rectangular prism. Measure the dimensions of a cereal box. What is the volume of the cereal box? What is the surface area of the cereal box? Hint: Create a net of the cereal box and use the net to calculate the surface area.

Week Three (if time permits):

- Students describe the two-dimensional figures that result from slicing right rectangular prisms and pyramids.

Parallel Cross-Sections of Prisms





Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 7 Math
Unit of Study	Unit 11: Geometric Drawing and Scaling
Pacing	Two Weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Priority/Focus Standard:

7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing, and reproducing a scale drawing at a different scale.

Supporting Standard:

7.G.A.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students* ***do****?*	***Concepts*** *What must students* ***know****?*
Students will be able to: • Solve problems involving scale drawings of geometric figures.	*Students will know/understand:* • Scale factor • Reduction • Enlargement
• Construct a scale drawing at a different scale.	• Scale drawing
• Calculate actual lengths and areas from a scale drawing.	• Scale factor • Reduction • Enlargement
• Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.	• Construction
• Construct triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.	• Construction

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are constructions of geometric shapes using scale factors useful?	1. Constructing geometric shapes and scale drawings can be applied to real world problem solving involving concepts such measurement and geometric relationships like building a scale model, architecture and construction, or map scale.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 2. Communication and collaboration: Students communicate and work collaboratively to support individual learning and contribute to the learning of others. 4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 2 (for classwork/HW practice problems) • Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions) ***Media:*** • Geometry software ***Online Resources/Websites:*** • IXL Lessons - Grade 7 Mathematics Ratios, Rates, and Proportions and Two-

Dimensional Figures

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Scale factor: ratio between corresponding measurements of an object or figure and a representation of the figure.
- Reduction: similar figure resulting from decreasing the size of the original figure.
- Enlargement: similar figure resulting from increasing the size of the original figure.
- Construction: geometric drawing of figures using accurate angles, shapes, and lines.

Learning Plan

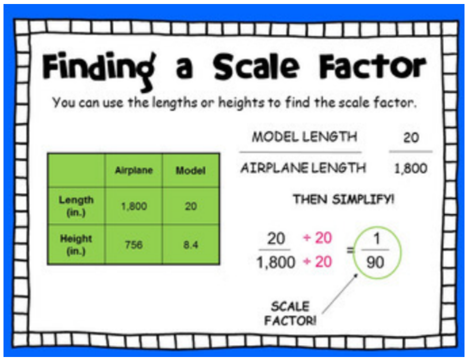
Overview and Key Learning Events and Instruction Per Week

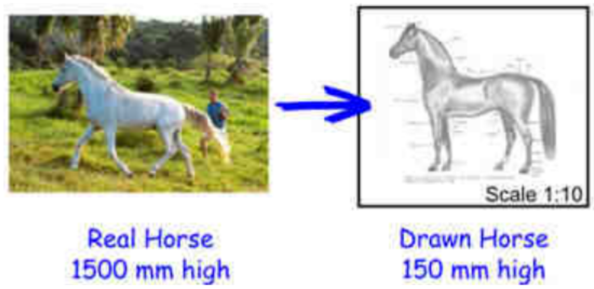
The standards in this unit are part of an *additional content cluster*. The emphasis is on drawing, constructing, and describing geometrical figures and describing their relationships. Students understand that a scale factor is applied to all side lengths of a drawing to create the new drawing or construction. Students reason about relationships among two-dimensional figures using scale and solve problems involving scale drawings and geometric constructions. Tools such as rulers and protractors are used to construct shapes either by hand or using computer technology. Students build on learning from previous units in regarding the relationships between angles formed by intersecting lines and work with three-dimensional figures, relating them to two-dimensional figures by examining cross sections (slicing).

Learning Tasks

Week One:

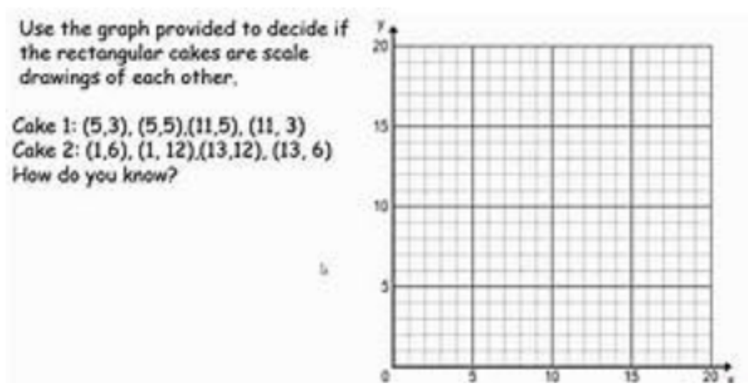
- Students construct a scale drawing at a different scale and calculate actual lengths and areas from a scale drawing.





- Students solve problems involving scale drawings of geometric figures.

Example:



Week Two:

- Students draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.

- Students construct triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

Westbrook Public Schools' Portrait of a Graduate

Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving

☐ Effectively Communicating

☐ Creatively Thinking

☒ Persevering

☐ Socially Aware

☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 1: Real Numbers
Pacing	Five weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

Work with radicals and integer exponents.
8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Solve equations of the form $\sqrt{x}$=p and $\sqrt[3]{x}$=p.

Know that there are numbers that are not rational and approximate them by rational numbers.
8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually and convert a decimal expansion which repeats eventually into a rational number.
8.NS.2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate

the value of expressions. For example, by truncating the decimal expansion of $\boxed{\sqrt{2}}$, show that $\boxed{\sqrt{2}}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.

Properties of Exponents and Scientific Notation.
8.EE.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions.

8.EE.3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.

Supporting Standard:

8.EE.4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Interpret scientific notation that has been generated by technology.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Understand that real numbers which are not rational are called irrational. The square roots of non-perfect squares and the cube roots of non-perfect cubes are irrational.	*Students will know/understand:* • Rational/Irrational Numbers • Perfect Squares/Non-Perfect Squares • Perfect Cubes/Non-Perfect Cubes • Square/Cube Roots
• Evaluate square roots of small perfect squares and cube roots of small perfect cubes; understand that perfect squares/cubes are not always whole numbers (e.g., 0.25, 8/27).	• Perfect Squares/Cubes • Whole Numbers • Rational Numbers
• Find an irrational number's approximate location on a number line and estimate the value of irrational square and cube roots.	• Perfect Squares/Non-Perfect Squares • Perfect Cubes/Non-Perfect Cubes • Rational Approximations

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- Solve equations involving square and cube roots.

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- Square/Cube Roots

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- Understand properties of integer exponents.

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<table>
<tr><th>Property</th><th>Rule with exponent</th><th>Rule with words</th></tr>
<tr><td>Power of One
a^1</td><td>a</td><td>Always base</td></tr>
<tr><td>Negative Power
a^{-m}</td><td>$\frac{1}{a^m}$</td><td>Flip sign of exponent, Flip base</td></tr>
<tr><td>Power of Zero
a^0</td><td>1</td><td>Always 1</td></tr>
<tr><td>Power of a Product
$a^m \times a^n$</td><td>a^{m+n}</td><td>Keep base add exponents</td></tr>
<tr><td>Power of a Power
$(a^m)^n$</td><td>$a^{m \cdot n}$</td><td>Keep base multiply exponents</td></tr>
<tr><td>Power of a Quotient
$\frac{a^m}{a^n}$</td><td>a^{m-n}</td><td>Keep base subtract exponents</td></tr>
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- Express very large or very small quantities using scientific notation and interpret numbers in scientific notation when displayed on a calculator.

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- Powers of Ten
- Scientific Notation

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- Perform calculations (multiply and divide) with numbers in scientific notation and estimate how much larger or smaller numbers expressed in scientific notation are relative to one another.

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- Scientific Notation
- Properties of Exponents

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Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What are real numbers?	1. All numbers that represent a quantity along a number line are classified as real numbers.

2. How are patterns useful in understanding numbers written in exponential form and scientific notation?	2. Patterns can be used to see the relationships among numbers expressed using the same base. Patterns involving powers of 10 can be used to convert numbers expressed in scientific notation to standard form.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can discern patterns and structure without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 8 Mathematics- Rational vs. Irrational Numbers, Scientific Notation, Exponent Rules

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Rational Number- any number that can be expressed as the quotient or fraction p/q of two integers, a numerator p and a non-zero denominator q.
- Irrational Number- any number that cannot be expressed as the ratio of two integers and having an infinite and non-recurring expansion when expressed as a decimal.
- Real Numbers- numbers that represent a quantity along a number line; comprised of the set of all rational and irrational number values.

- Perfect Square- the product of a rational number multiplied by itself.
- Square Root- a value *y* that, when multiplied by itself, gives the number *a*;
  Notation: $\sqrt{a} = y$ OR $y^2 = a$
- Perfect Cube- a number that is the cube of an integer.
- Cube Root- a value *y* that, when cubed, produces a number *a*;
  Notation: $\sqrt[3]{a} = y$ OR $y^3 = a$
- Scientific Notation- a way of expressing very large or very small number values as the product of a decimal number between one and 10 (or equal to 1) and a power of 10.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Radicals and Rational vs. Irrational Numbers:

The standards in this portion of the unit are part of a *supporting content cluster*. In grade seven, students became fluent in rational number operations. In grade eight, students learn to understand that a number that is not rational is irrational. Students learn how to find the approximate value of an irrational number and its location on a number line. They also estimate the value of expressions with irrational numbers. Students use square roots and cube roots to solve equations, and they evaluate square roots of small perfect squares and cube roots of small perfect cubes. Later this year, students will use their knowledge of square roots, cube roots, and rational numbers to explore the Pythagorean Theorem, Volume, and the Properties of Exponents.

Properties of Exponents and Scientific Notation:

The standards in this portion of the unit are part of a *major content cluster*. Students learn to apply the properties of integer exponents and write equivalent expressions. They express very large or very small quantities using powers of 10. Students understand how to express numbers in scientific notation and how to use scientific notation to simplify computations and efficiently express very large and very small number values.

Learning Tasks

Week One:

- Powers and Exponents- understand expanded form of a monomial.
  - Vocabulary: base, exponent, power, monomial

$$5 \cdot x^3 \cdot y^4 = 5 \cdot x \cdot x \cdot x \cdot y \cdot y \cdot y \cdot y$$

- <u>Negative Exponents</u>- evaluate powers with negative exponents.

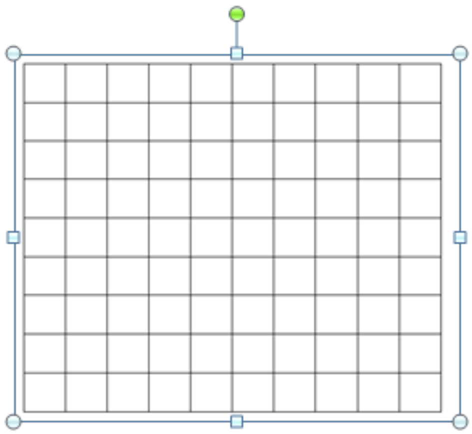
$$n^{-a} = \frac{1}{n^a}$$

Week Two:

- <u>Perfect Squares and Square Roots</u>- understand the relationship between perfect squares and square roots; evaluate positive and negative square roots of perfect squares; given the area of a square, find the side length and perimeter; estimate the value of the square roots of non-perfect squares.

<u>Introductory Activity</u>:

Draw two four-sided figures on the grid below. One must have an area of 25 square units and the other must have an area of 18 square units. Use two different colors to shade in your figures.



<u>Follow-up questions:</u>
Describe each of your shapes. Which one is a square? Why? Which is a rectangle? Why?

Examples for Differentiation:

<u>Level 1 Problems (for ***all*** students):</u>

1) If the area of a square is 36 square inches, find the perimeter.

<u>Level 2 Reasoning Problems (for ***all*** students):</u>

1) The total area of the figure below is 96 square centimeters. The figure is made up of equal-sized squares. What is the perimeter of the figure?

2) A square picture frame encloses an area of 32 square inches. Its owner claims that the frame side lengths are between 5.5 and 5.7 inches. Is the owner correct? Show your work and explain.

Level 3 Challenge Problems (for ***accelerated*** learners):

1) A concert crew needs to set up some chairs on the floor level. The chairs are to be placed in a square pattern consisting of four-square sections. If one of the square sections holds 900 chairs, how many chairs will be along each length of the larger square?

2) A bulletin board consists of four equal-sized cork squares arranged in a row to form a rectangle. If the total area of all four cork squares is 100 square feet, what is the length in feet of the bulletin board?

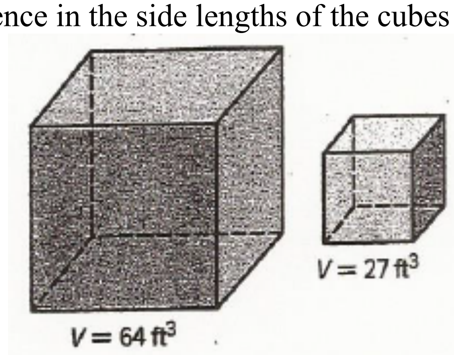
Week Three:

- Perfect Cubes and Cube Roots- understand the relationship between perfect cubes and cube roots; evaluate cube roots of perfect squares; given the volume of a cube, find the side length; estimate the value of the cube roots of non-perfect cubes.

Examples for Differentiation:

Level 1 Problems (for ***all*** students):

1) What is the difference in the side lengths of the cubes shown below?



Level 2 Reasoning Problems (for ***all*** students):

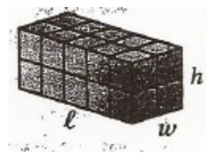
1) A company sells only items that are in the shape of **cubes**. Select all of the volumes of cubes with **integer** side lengths. Justify next to each choice.

a) 8 cubic in

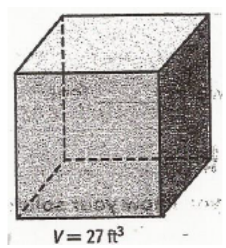
b) 33 cubic centimeters
c) 1.5 cubic feet
d) 9 cubic feet
e) 1,000 cubic meters

Level 3 Challenge Problems (for ***accelerated*** learners):

1) The volume of the rectangular prism shown is 4,320 cubic centimeters. What is the surface area of the prism?



2) Dario wants to buy paper to wrap a birthday present in the cube-shaped box shown below. If an 8.3 square foot package of wrapping paper costs $1.25, how much will Dario spend on the wrapping paper? Show your work and explain.



- Rational vs. Irrational Numbers- classify real vs. non-real numbers and rational vs. irrational numbers.

Real *vs.* ***Non-Real***

↙ ↘

Rational ***Irrational***

↓

Integer

↓

Whole Number

↓

Natural Number

Example: $\sqrt{-25}$

Level 1 Problems (for ***all*** students):

1) Determine whether each number is rational or irrational.

	Rational	Irrational
$\frac{1}{\sqrt{9}}$	☐	☐
$\sqrt{17}$	☐	☐
$-1\frac{2}{3}$	☐	☐
0.423	☐	☐

Level 2 Reasoning Problems (for ***all*** students):

- ***Part A***: Select all of the sets of numbers to which $\sqrt{60}$ belongs.
- ***Part B***: Change one digit in the number $\sqrt{60}$ so that the value belongs to a different set of numbers. Explain why changing that digit changes the sets to which the value belongs.

Level 3 Challenge Problems (for ***accelerated*** learners):

1) A student made the conjecture, "If I calculate the square root of a non-integer rational number, I will always get an irrational number." For example, $\sqrt{3.6}$ is an irrational number, $\sqrt{\frac{1}{3}}$ is an irrational number, and 3.6 and $\frac{1}{3}$ are non-integer rational numbers." Provide an example of a non-integer rational number that proves this student's conjecture is not always true. **Explain** your choice.

Week Four:

- Base 10 and Scientific Notation- express very large or very small quantities using powers of 10; understand what scientific notation looks like through technology; choose units of appropriate size for measurements; multiply and divide numbers using scientific notation; solve problems with scientific notation.

Examples for Differentiation:

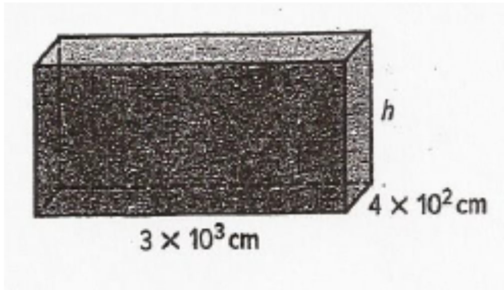
Level 1 Problems (for ***all*** students):

1) A website averages $4.5 \cdot 10^4$ hits per day. How many hits will it get in 360 days?
2) The area of land that Rhode Island covers is about $1.5 \cdot 10^3$ square miles. The area of the land that Alaska covers is about $6.45 \cdot 10^5$ square miles. Approximately how many times larger is the area of Alaska than the area of Rhode Island?

Level 2 Reasoning Problems (for ***all*** students):

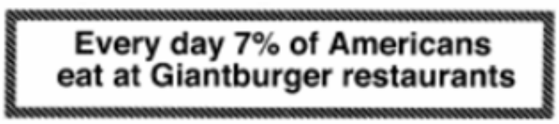
1) The volume of the rectangular prism below is $4.8 \cdot 10^9$ cubic centimeters.

Find the height, h, of the prism expressed in standard notation.



Level 3 Challenge Problems (for ***accelerated*** learners):

The headline below appeared in a newspaper:



There are about $8 \bullet 10^3$ *Giantburger restaurants in America. Each restaurant serves about* $2.5 \bullet 10^3$ *people every day.*

a) Write an expression that represents the total number of people who eat at Giantburger restaurants each day.

b) Evaluate the expression you wrote in part a. Give your answer in scientific notation and standard form.

c) There are about $3 \bullet 10^8$ *Americans. Use your answer to part b to express what fraction of the American population eats at Giantburger restaurants each day.*

d) Use your rational number from part c) to determine if the claim made in the headline is accurate. ***Explain****.*

Week Five:

- Properties of Integer Exponents- apply properties for integer exponents:

$$x^4 \cdot x^5 = (x \cdot x \cdot x \cdot x)(x \cdot x \cdot x \cdot x \cdot x) = x^9 = x^{4+5}$$

$$\frac{x^6}{x^2} = \frac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{x \cdot x} = x \cdot x \cdot x \cdot x = x^4 = x^{6-2}$$

$$\left(x^3\right)^4 = (x \cdot x \cdot x)(x \cdot x \cdot x)(x \cdot x \cdot x)(x \cdot x \cdot x) = x^{12} = x^{3 \cdot 4}$$

- Create equivalent expressions:

$$3^2 \cdot 3^{-5} = 3^{-3} = \frac{1}{3^3} = \frac{1}{27}$$

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): See "leveled" problem solving Learning Tasks. Provide intervention and extra practice examples so that all students can solve the level one problem independently. Model strategies and provide support with the level two questions.
Enrichment: See "challenge" questions included in the problem-solving Learning Tasks. Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS

students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice
Summative Assessments and Corresponding Rubrics/Checklists when applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 2: The Pythagorean Theorem
Pacing	Five Weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
(Practices in ***bold*** *are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

8.G.6. Explain a proof of the Pythagorean Theorem and its converse.

8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Supporting Standard:

8.NS.2. Use rational approximations of irrational numbers to compare the size of irrational

numbers, locate them approximately on a number line diagram, and estimate the value of expressions.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Explain a proof of the Pythagorean Theorem and its converse.	*Students will know/understand:* • Right Triangles • Hypotenuse and Legs • $a^2 + b^2 = c^2$
• Apply the Pythagorean Theorem to determine unknown side lengths in right triangles.	• Solutions to equations • $a^2 + b^2 = c^2$ • Square roots of perfect/non-perfect squares • Rational/Irrational Numbers
• Apply the Pythagorean Theorem to find the distance between two points on the coordinate plane.	• The Cartesian Coordinate System • Solutions to equations • $a^2 + b^2 = c^2$ • Square roots of perfect/non-perfect squares • Rational/Irrational Numbers
• Evaluate square roots of perfect/non-perfect squares.	• Perfect Squares • Rational/Irrational Numbers
• Recognize common Pythagorean Triples.	• Similar Right Triangles • $a^2 + b^2 = c^2$
• Solve multi-step problems in two and three dimensions.	• Right Triangles • Hypotenuse and Legs • $a^2 + b^2 = c^2$ • Solutions to equations • Rational/Irrational Numbers • The Cartesian Coordinate System

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*

1. How are geometric relationships useful?	1. The Pythagorean Theorem can be applied to find the unknown side lengths in a right triangle.
2. What is the purpose of the Pythagorean Theorem?	2. The Pythagorean Theorem can be applied to real-world problem solving in two and three dimensions.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

6. Technology operations and concepts:
Students demonstrate a sound understanding of technology concepts, systems, and operations.

*Use of calculator permitted for all student work as calculation is not part of any of the assessed priority standards in this unit; *recommended online calculator: desmos scientific*

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media:

- Calculator; *recommended online calculator: desmos scientific.*

Online Resources/Websites:

- IXL Lessons- Grade 8 Mathematics, The Pythagorean Theorem

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Right Triangle- a triangle with exactly one right (90°) angle.
- Legs- the adjacent sides of a right triangle that form the 90°angle.
- Hypotenuse- the side opposite the 90°angle in a right triangle.

- The Pythagorean Theorem- if a triangle is right, then $a^2 + b^2 = c^2$
- Converse of the Pythagorean Theorem- if $a^2 + b^2 = c^2$, then the side lengths form a right triangle.
- Pythagorean Triple- any set of three side lengths that satisfy the Pythagorean Theorem.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students further their knowledge of rational and irrational numbers by continuing to find the value of square roots of perfect squares and by estimating the value of square roots of non-perfect squares. Students explain a proof of the Pythagorean Theorem and its converse, and then they apply the theorem to determine the missing side lengths in a right triangle and to find the distance between two points on the coordinate plane. Finally, students apply the theorem to multi-step real-world problems in two and three dimensions.

Learning Tasks

Week One:

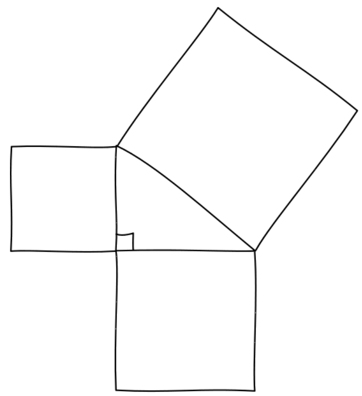
- Explain a geometric proof of the Pythagorean Theorem and its converse; students will discover that the sum of the areas of the squares attached to the legs of a right triangle is equal to the area of the square attached to the hypotenuse.

Example:

Two legs of a right triangle measure 9 cm and 12 cm.

1) If squares were attached to each side of this triangle, calculate the area of each square.

Write the area inside of each square below.



2) Find the length of the hypotenuse of the right triangle. Show how you arrived at your answer.

- Apply the Pythagorean Theorem to find the value of the missing side length (leg or hypotenuse) of a right triangle; apply the converse of the Pythagorean Theorem to determine whether three side lengths form a right triangle.

Week Two:

- Apply the Pythagorean Theorem to one-step problem solving questions.

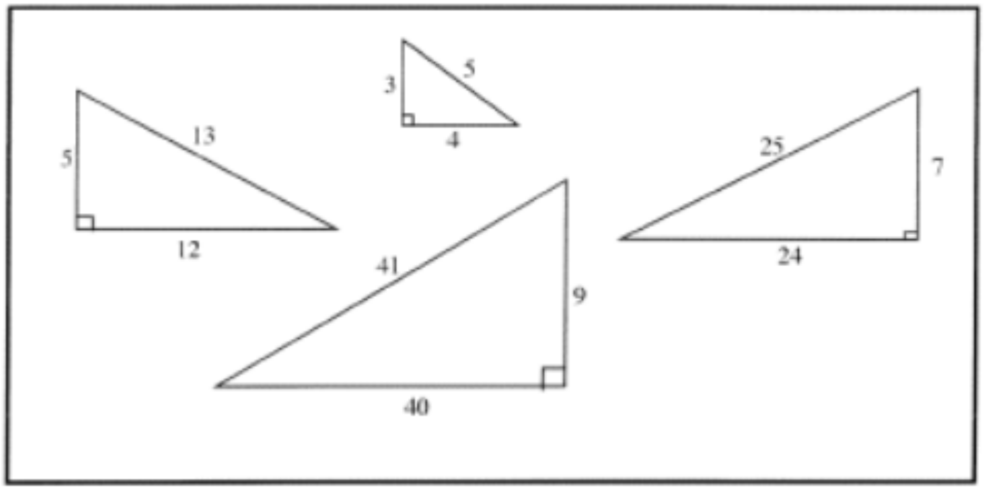
Examples:

1) A right triangle has a hypotenuse with a length of 20 units. One of the legs measures 16 units. Find the measure of the other leg.

2) Triangle STV has sides with lengths of 7, 11, and 14 units. Determine whether this triangle is a right triangle. Show all work necessary to justify your answer. If it is not a right triangle, determine what type of triangle it is.

Week Three:

- Apply common Pythagorean Triples to problem solving tasks.



(3, 4, 5), (5, 12, 13), (7, 24, 25) and (9, 40, 41) are called Pythagorean Triples because they satisfy the condition

$$c^2 = a^2 + b^2$$

- Apply the Pythagorean Theorem to calculate the distance between two points on the coordinate plane.

Examples:

1)

What is the distance between (0, 0) and (8, 15) on the *xy*-coordinate plane?

(A) 7 units
(B) 8 units
(C) 17 units
(D) 23 units

2)

Select whether each line segment has a length of 25 units. 8.G.8

Yes	No	
☐	☐	segment *AB* with endpoints *A*(0, 0) and *B*(15, 20)
☐	☐	segment *CD* with endpoints *C*(–1, 2) and *D*(7, 17)
☐	☐	segment *AD* with endpoints *A*(2, 4) and *D*(9, 28)

Week Four:

- Solve multi-step problems including problems involving distance on the coordinate plane.

Examples for Differentiation:

Level 1 Problems (for ***all*** students):

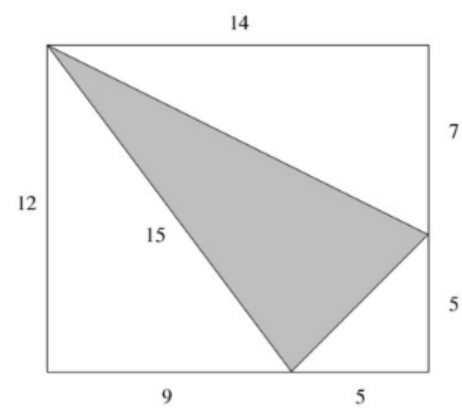
1) A 35-foot ladder is leaning on a house. The bottom of the ladder is 21 feet from the house. Find the height, h, from the ground to the window.

2) Two sides of a right triangle have lengths of 3 feet and 5 feet. Find the two possible lengths for the third side.

Level 2 Reasoning Problems (for ***all*** students):

1) A 13-foot ladder is placed 5 feet away from the base of a wall. The distance from the ground straight up to the top of the wall is 12.5 feet. Will the ladder reach the top of the wall? Include a diagram. Explain your answer.

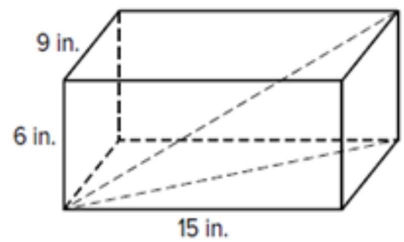
2) Three right triangles surround a shaded triangle. Together they form a rectangle measuring 12 units by 14 units. The figure below shows some of the dimensions but is not drawn to scale.



Is the shaded triangle a right triangle? Justify your response by explaining/showing your work.

Level 3 Challenge Problems (for ***accelerated*** learners):

1) A pet spider is kept in a shoebox and sleeps in the bottom front left corner. She strings a web from her sleeping corner and along it to the top back right corner. To return to her sleeping corner, she walks down the edge of the box and across the bottom to the front left corner. How much farther did she walk on her return walk? Show your work. Round the final answer to the nearest tenth.



2) When Joe drives to school, he picks up his friend Dave. Dave lives directly south of Joe. Their school is directly east of Joe's house. Joe usually drives an average of 30 miles per hour. If Joe lives 12 miles from Dave, and Dave lives 20 miles from school, how much time would Joe save if he did not have to pick up his friend Dave? Draw a diagram and show your work/explain.

Week Five:

- Apply the Pythagorean Theorem to multi-step problems; use small group pairings of students, small group instruction/re-teaching of strategies, or independent practice.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): See "leveled" problem solving Learning Tasks. Provide intervention and extra practice examples so that all students can solve the level one problem independently. Model strategies and provide support with the level two questions.

Enrichment: See "challenge" questions included in the problem-solving Learning Tasks. Beginning in week two, change the orientation of the figures or include rational and irrational number side lengths to provide a challenge for accelerated learners. Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when applicable:

- Quizzes
- Unit Test
- Problem Solving Assessment w/rubric (see below)

Problem Solving Rubric

Score	*Level*	*Description*
1	*Does Not Meet Standard*	*Unable to apply problem solving strategies without significant teacher prompting; demonstrates a very limited understanding of the mathematical concepts used to solve problems; demonstrates no evidence of the mathematical reasoning used to solve problems*
2	*Working Toward Standard*	*Applies problem solving strategies with teacher prompting; demonstrates a limited understanding of the mathematical concepts used to solve problems; demonstrates limited evidence of the mathematical reasoning used to solve problems*
3	*Approaching Standard*	*Applies problem solving strategies with some teacher prompting; demonstrates an understanding of some of the mathematical concepts used to solve problems; demonstrates some evidence of the mathematical reasoning used to solve problems*
4	*Meets Standard*	*Applies problem solving strategies independently; demonstrates a substantial understanding of the mathematical concepts used to solve problems; effectively communicates the mathematical reasoning used to solve problems*
**5*	*Exceeds Standard*	*Independently solves problems beyond grade level expectations; can apply multiple strategies to solve problems; demonstrates a complete understanding of the mathematical concepts used to solve problems; demonstrates complex and/or abstract mathematical reasoning to solve problems*

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 3: Transformations: Understanding Congruence and Similarity
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

8.G.1. Verify experimentally the properties of rotations, reflections, and translations:
a) Lines are taken to lines, and line segments to line segments of the same length.
b) Angles are taken to angles of the same measure.
c) Parallel lines are taken to parallel lines.

8.G.2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

8.G.3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
8.G.4. Understand that a two dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given

two similar figures, describe a sequence that exhibits the similarity between them.

Supporting Standard:

8.G.5 Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so*.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: • Graph the effect of translations, reflections, rotations, and dilations on two-dimensional figures using coordinates.	*Students will know/understand:* • The Cartesian Coordinate System • Translation • Reflection • Rotation • Dilation
• Understand that two-dimensional figures are congruent if a sequence of translations, reflections and/or rotations can be applied to map the preimage to its image.	• Translation • Reflection • Rotation • Congruence
• Describe a sequence of transformations that verifies the congruence between two figures.	• Translation • Reflection • Rotation • Congruence
• Understand that two-dimensional figures are similar if a sequence of transformations *which includes a dilation* can be applied to map the preimage to its image.	• Dilation • Similarity
• Describe a sequence of transformations that verifies the similarity between two figures.	• Translation • Reflection • Rotation • Dilation

	• Similarity
• Find the scale factor between two similar figures.	• Dilation • Similarity • Scale Factor

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are geometric relationships useful?	1. Transformations can be applied to demonstrate congruence and similarity between two-dimensional figures.
2. What is the purpose of transformations?	2. Transformations enhance logical thinking and spatial awareness.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

2. Communication and collaboration:
Students communicate and work collaboratively to support individual learning and contribute to the learning of others.

Informational Texts

Informational Books:
- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:
- IXL Lessons- Grade 8 Mathematics, Transformations - Congruence and Similarity

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Translation: a transformation that moves (slides) an object in space without changing its size, shape, or orientation.
- Reflection: a transformation that flips an object across a line without changing its size or shape.
- Rotation: a transformation that turns an object about a fixed point without changing its size or shape.
- Dilation: a transformation that expands or contracts the size of an object without changing its shape or orientation.
- Scale factor: the ratio of any two corresponding lengths in similar geometric figures.
- Congruent figures: figures with the same shape and size.
- Similar figures: two figures that have the same shape, corresponding side lengths proportional and corresponding angles congruent.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students graph translations, reflections, rotations, and dilations on the coordinate plane. Students verify that two figures are congruent if one can be obtained from the other through a sequence of translations, reflections, and/or rotations. Students verify that two figures are similar if one can be obtained from the other through a sequence of transformations which include a dilation.

Learning Tasks

Week One:

- Graph the effect of translations and reflections using coordinates; write an algebraic representation of the coordinates.

Examples:

Graph the preimage and the resulting image after the given transformation is performed.
List the coordinates of the vertices of the new image. Write the algebra representation.

1) Parallelogram GHIJ with G (2, 2), H (6, 0), I (6, 2), and J (2, 4) translated 2 units left and 3 units up.
2) Triangle ABC with A (3, -3), B (5, -4), C (5, -1) is reflected over the x-axis.
3) Triangle ABC with A (3, -3), B (5, -4), C (5, -1) is reflected over the y-axis.

Week Two:

- Graph the effect of rotations (about the origin and a fixed point) using coordinates; write an algebraic representation of the coordinates for a rotation about the origin; understand that two-dimensional figures are congruent if a sequence of translations, reflections and/or rotations can be applied to map the preimage to its image.

Examples:

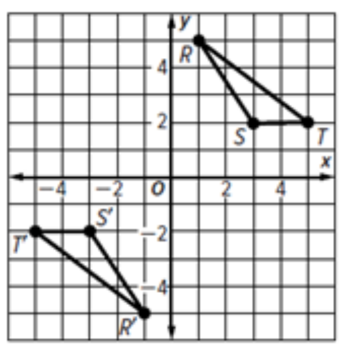
1) Graph the preimage and the resulting image after the given transformation is performed. List the coordinates of the vertices of the new image. Write the algebra representation.

   Trapezoid MNOP with M (2, 1), N (3, 4), O (5, 4), and P(6, 1) rotated 90 degrees counterclockwise about the origin.

2) Graph the preimage and the resulting image after the given transformation is performed. List the coordinates of the vertices of the new image.

   Trapezoid MNOP with M (2, 1), N (3, 4), O (5, 4), and P(6, 1) rotated 180 degrees clockwise about point M.

3) Triangle R'S'T' is the image of triangle RST after one or more transformations. Select whether each transformation or sequence of transformations produces triangle R'S'T'.



Yes	No	
☐	☐	Triangle *RST* is rotated 180° about the origin.
☐	☐	Triangle *RST* is reflected across the *y*-axis and then reflected across the *x*-axis.
☐	☐	Triangle *RST* is reflected across the *y*-axis and then translated 4 units down.

Week Three:

- Apply a scale factor to graph the effect of a dilation using coordinates; write an algebraic representation of the coordinates; find the scale factor between two similar figures; understand that two-dimensional figures are similar if a sequence of transformations which includes a dilation can be applied to map the preimage to its image.

Examples for Differentiation:

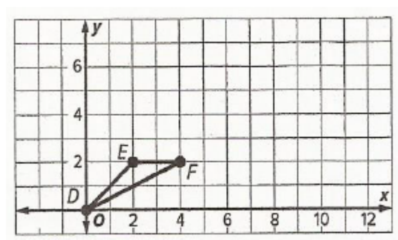
Level 1 Problems (for ***all*** students):

1) Graph the preimage and the resulting image after the given transformation is performed. List the coordinates of the vertices of the new image. Write the algebra representation.

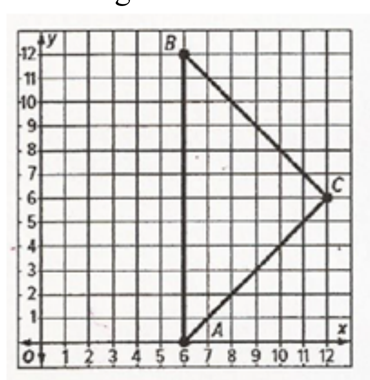
   - ➔ Enlargement: Trapezoid GHIJ with G(-4, 2), H(-2, 4), I(4, 4), and J(-4, -4) is dilated by a scale factor of 2.
   - ➔ Reduction: Trapezoid GHIJ with G(-4, 2), H(-2, 4), I(4, 4), and J(-4, -4) is dilated by a scale factor of 0.5.

Level 2 Reasoning Problems (for ***all*** students):

1) Triangle DEF is dilated so that the image of point F is F' (8, 4). What is the scale factor of the dilation? Is the dilation an enlargement or a reduction?



2) Triangle ABC is dilated so that the image of point B is B' (2, 4). What is the scale factor of the dilation? Is the dilation an enlargement or a reduction?



Level 3 Challenge Problems (for ***accelerated*** learners):

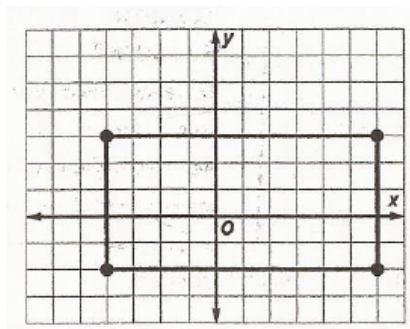
1) A square photograph has 12-inch long sides. Martin has the photograph enlarged so its new perimeter is 192 inches. Write the correct numbers to complete each statement.

The perimeter of the enlargement is ______ times the perimeter of the original.

The area of the enlargement is ______ times the area of the original.

The area of the enlargement is ______ square inches.

2) The rectangle below is dilated, increasing both dimensions by 20%. Then the new image, P', is dilated again, decreasing both dimensions by 20%. The perimeter of the final image, P", is related to the original perimeter, P, by the equation. What is the value of x?



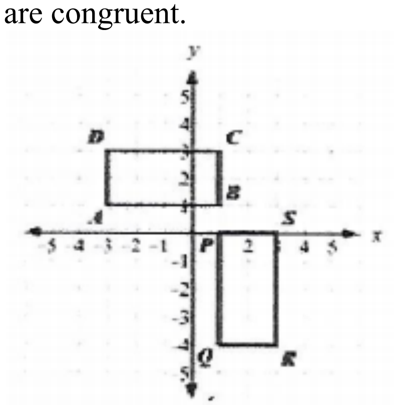
Week Four:

- Graph a compound transformation using coordinates; describe a sequence of transformations that verifies the congruence between two figures; describe a sequence of transformations (that includes dilation) that verifies two figures are similar.

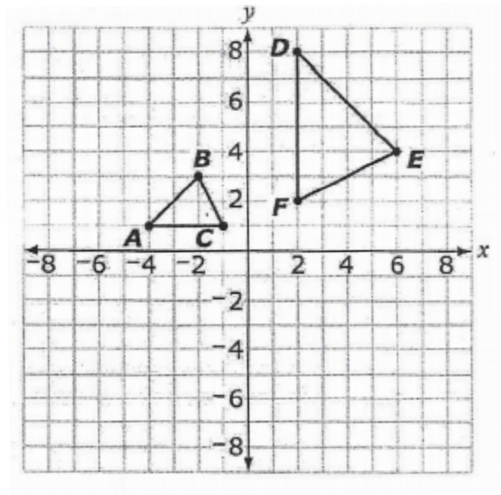
Examples for Differentiation:

<u>Level 1 Problems (for ***all*** students):</u>

1) Describe a sequence of transformations that will map ABCD onto triangle PQRS to verify that the rectangles are congruent.



2) Describe a sequence of transformations that will map ABC onto DEF to verify that the triangles are similar.



Level 2 Reasoning Problems (for ***all*** students):

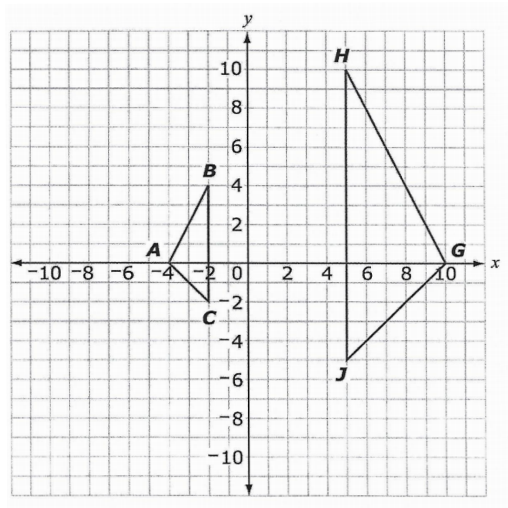
1) Which transformation would give the same result as a reflection of a figure over the y-axis followed by a reflection over the x-axis?

   A. a translation 5 units to the right
   B. a 180-degree clockwise rotation about the origin
   C. a 90-degree counterclockwise rotation about the origin
   D. a 180-degree clockwise rotation about a vertex of the figure

2) Select **all** transformations below that would return a figure to its original position in the coordinate plane.

   A. reflect over the x-axis, then reflect the result over the y-axis.
   B. rotate 360 degrees about the origin.
   C. translate by *(x + 4, y - 3)*, then translate the result by *(x - 4, y + 3)*
   D. dilate by a scale factor of 4, then dilate the result by a scale factor of 0.25.

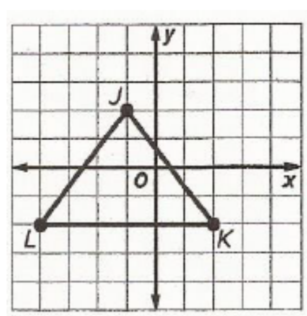
3) Triangle ABC is reflected over the y-axis and then dilated to form triangle GHJ. What is the scale factor of the dilation?



<u>Level 3 Challenge Problems (for ***accelerated*** learners):</u>

1) A blue rectangular tile and a red rectangular tile are <u>similar</u>. The blue tile has a length of 10 inches and a perimeter of 30 inches. The red tile has a length of 6 inches. What is the perimeter of the red tile? Show your work below. Include diagrams.

2) Triangle JKL is reflected over the x-axis to form triangle J'K'L'. Triangle J'K'L' is then rotated 90 degrees clockwise about point L' to form triangle J"K"L". Name the coordinates of K".



Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): See "leveled" problem solving Learning Tasks. Provide intervention and extra practice examples so that all students can solve the level one problem independently. Model strategies and provide support with the level two questions.
Enrichment: See challenge questions included in the problem-solving Learning Tasks. Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when Applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when Applicable: • Quizzes • Unit Test • Problem Solving Assessment w/rubric (see Unit 2)

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 4: Solving Equations with One Variable
Pacing	Three weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

(Practices in ***bold*** *are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

8.EE.7. Solve linear equations in one variable.

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Unwrapped Priority Standards

Skills/Suggested Outcomes	***Concepts***

*What must students **do**?*	*What must students **know**?*
Students will be able to: ● Model and solve linear equations in one variable using algebra tiles.	*Students will know/understand:* • Terms • Equations • Algebra Tiles
● Solve linear equations in one variable that have rational number coefficients.	• Variable • Constants • Coefficients • Solution
● Solve linear equations in one variable using the distributive property.	• Variable • Constants • Coefficients • Distributive Property • Solution
● Solve linear equations in one variable by combining like terms on one or both sides of the equal sign.	• Term • Like Terms • Variable • Constants • Coefficients • Solution
● Determine whether equations with variables on both sides have one solution, infinitely many solutions, or no solution.	• Term • Like Terms • Variable • Constants • Coefficients • Distributive Property • Solution

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. What types of solutions can equations with variables on both sides produce?	1. Linear equations in one variable may have one solution, infinitely many solutions, or no solution.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

- Calculator not permitted; the objectives of the unit are centered around developing mathematically proficient students who can solve one-variable equations without the use of technology.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media: N/A

Online Resources/Websites:

- IXL Lessons- Grade 8 Mathematics, Solving Equations with One Variable

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Term- a single number (constant) or variable, or the product of numbers and variables.
- Like Terms- terms that contain the same variables raised to the same power.
- Variable- an unknown quantity that may change within the context of a mathematical problem or experiment.
- Constant- a fixed value (a number).
- Coefficient- a fixed value (constant) by which a variable is multiplied.
- Distributive Property: $a(b+c) = ab + ac$
- Solution- the value(s) of the variable that makes an equation true.

Learning Plan

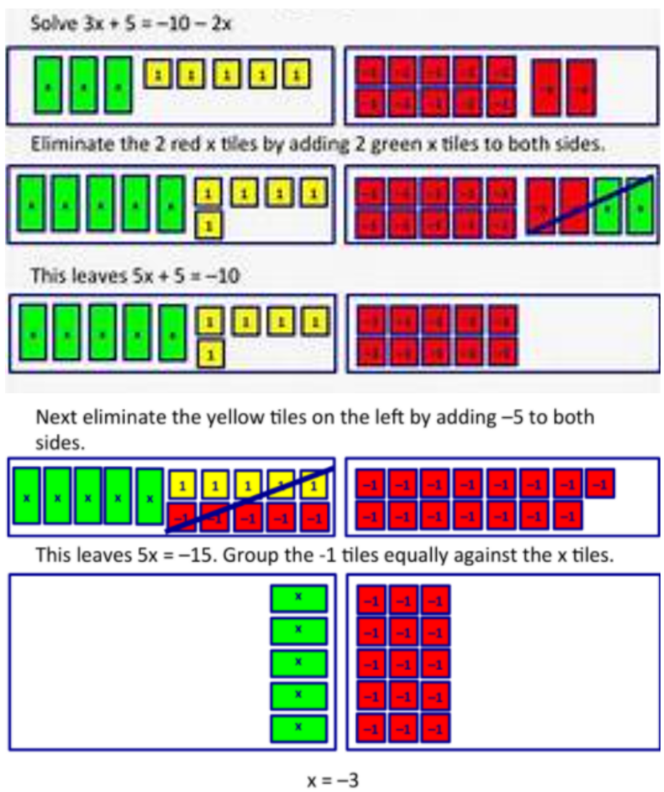
Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students learn to solve linear equations with one variable resulting in one solution, infinitely many solutions, or no solution. They also solve linear equations with rational number coefficients, requiring the distributive property and combining like terms. Later this year, students will use their knowledge from this unit when studying Two-Variable Linear Equations and Systems of Equations.

Learning Tasks

Week One:

- Model expressions and equations using algebra tiles; review solving one- and two- step equations using the properties of equality for addition, subtraction, multiplication, and division; solve linear equations in one variable that have rational number coefficients.



Week Two:

- Solve multi-step linear equations in one variable by combining like terms and applying the distributive property.
- Solve real world problems by modeling a situation with a linear equation (see example #1 below).

Week Three:

- Solve multi-step linear equations in one variable by combining like terms on one or both sides of the equal sign.
- Determine whether linear equations in one variable have one solution, infinitely many solutions, or no solution.
- Solve real world problems by modeling a situation with a linear equation that has variables on both sides (see example #2 below).

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☐ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

Solve real world problems by modeling a situation with a linear equation:

1) Identify known quantities.
2) Assign a variable to represent the unknown quantity.
3) If there is more than one unknown quantity, find a way to write the second unknown in terms of the first.
4) Write an equation interpreting the words as mathematical operations.
5) Solve the equation. Be sure the solution can be explained in words, including the units of measure.

Example #1:
One number exceeds another number by 17 and their sum is 31. Find the two numbers.

Solution:
Let x represent the first number. Then, as the second number exceeds the first by 17, we can write the second number as x + 17. The sum of the two numbers is 31, so the equation becomes:

$x + (x + 17) = 31$

$2x + 17 = 31$

$2x = 14$

$x = 7$

$x + 17 = 24$

The two numbers are 7 and 24.

Example #2:
At one gym, there is a $12 start-up fee, and after that each month at the gym costs $20. At another gym, there is a $4 start-up cost, but after that, each month at the gym costs $22. After how many months will the cost of both gyms be the same?

Solution:
Let m = the number of months.

Set the total costs for ***m*** months at the two gyms equal.

$$12 + 20m = 4 + 22m$$

$$12 = 4 + 2m$$

$$8 = 2m$$

$$4 = m$$

After 4 months, the cost at both gyms ($92) will be the same.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, restructuring of learning activities, or the use of more appropriately challenging materials (algebra tiles). Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice
Summative Assessments and Corresponding Rubrics/Checklists when applicable: • Quizzes • Pre- and Post-Assessment

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 5: Linear Equations, Functions, and Patterns in Data
Pacing	Seven weeks

CT Core Standards

What are the goals of this unit?

Mathematical Practices:

*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

8.EE.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*

8.EE.6. Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.

8.F.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

8.F.2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*

8.F.3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.

8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

8.F.5. Describe qualitatively the functional relationship between two quantities by analyzing a graph, (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Supporting Standards:

8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

8.SP.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

8.SP.4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Graph proportional relationships and interpret the unit rate as slope	*Students will know/understand:* ● Proportional relationships ● Unit rate ● Slope (m) and rate of change
● Compare proportional relationships	● Proportional relationships ● Unit rate ● Slope (m) and rate of change
● Determine the rate of change and the initial value of a linear relationship	● Slope (m) and rate of change ● y-intercept (b) and initial value
● Calculate the slope between any two points on a line using slope triangles	● Slope (m) and rate of change ● Slope Triangle
● Write linear functions: $y = mx$ and $y = mx + b$	● Proportional Relationships ● Slope (m) and rate of change ● y-intercept (b) and initial value ● Linear functions
● Graph sets of ordered pairs as solutions to linear equations	● Graphs of linear functions
● Compare linear functions expressed as tables, equations and graphs	● Tables, graphs, equations ● Slope-Intercept Form of a Linear Equation
● Construct functions and understand function rules	● Linear functions ● Input/Output

• Recognize examples of non-linear functions	• Functions- linear vs. non-linear
• Construct and interpret scatter plots	• Two-Variable Relationships
• Describe patterns and associations between variables	• Scatter Plots • Positive or Negative Correlations
• Draw a line of best fit and determine the equation of a linear model	• Scatter Plots • Positive or Negative Correlations • Line of Best Fit
• Display frequencies and relative frequencies and interpret in a two-way table	• Two-way Tables • Frequencies

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are linear relationships described?	1. Linear relationships can be described using the rate of change (slope) and the initial value (y-intercept). Tables, graphs and equations can be created.
2. How can linear functions be compared?	2. Linear functions can be compared by displaying data in a table or a graph or by writing an equation.
3. How can predictions about data be made?	3. A line of best fit can be used to make predictions about data; patterns of association can also be seen in bivariate categorical data by displaying relative frequencies in a two-way table.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media:

- Graphing Calculator Utility
- Videos:
  - Introduction to Slope
  - Graphing Lines by Plotting Points
  - Is the Ordered Pair a Solution?
  - Finding Slope and y-intercepts
  - Graphing Lines Using Slope-Intercept Form (y=mx+b)

Online Resources/Websites:

- IXL Lessons- Grade 8 Mathematics: Slope, Linear Functions, Scatterplots, Line of Best Fit

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Proportional relationship- a special kind of linear relationship in which the two quantities vary directly with one and other. If one item is doubled, the other, related item is also doubled; also called a *direct variation.*
- Unit rate- the ratio of two measurements in which the second quantity is one.
- Slope- a number that describes both the direction and the steepness of a line.

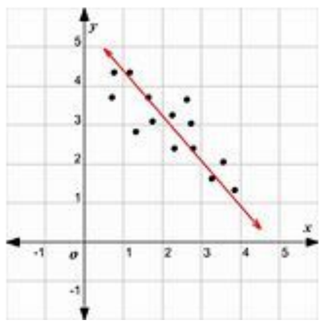
$$\text{Slope} = \frac{rise}{run}$$

- y-intercept- the point where a line intersects the y-axis.
- Linear relationship- a relationship between two quantities where one quantity has a constant rate of change with respect to the other; graph of the relationship is a line; the equation can be expressed in the form $y = mx + b$

- Function- a relation between a set of inputs and a set of possible outputs where each input is related to exactly one output.

- Scatter Plot- a graph of plotted points that shows the relationship between two sets of data.

- Line of Best Fit- a line through a scatter plot of data points that best expresses the relationship between those points; also called a *trend line.*



- Two-way Tables- a table that describes two categorical data variables together and contains the number of cases for each combination of the categories in both variables.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The linear function standards in this unit are part of a *major content cluster*. These concepts are a critical area of the grade eight curriculum and should be taught at the developmental and reinforcement level. Students understand the connections between proportional relationships, lines, and linear equations as they interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. They understand that ordered pairs on a non-vertical line are the solutions of the equation $y = mx + b$, where m is the slope of the line as well as the unit rate. Students understand that $y = mx + b$ defines a linear function and what a nonlinear function looks like. Students need to be fluent with using, interpreting, and comparing linear functions by the end of grade eight. In high school algebra, students will deepen their knowledge of nonlinear functions.

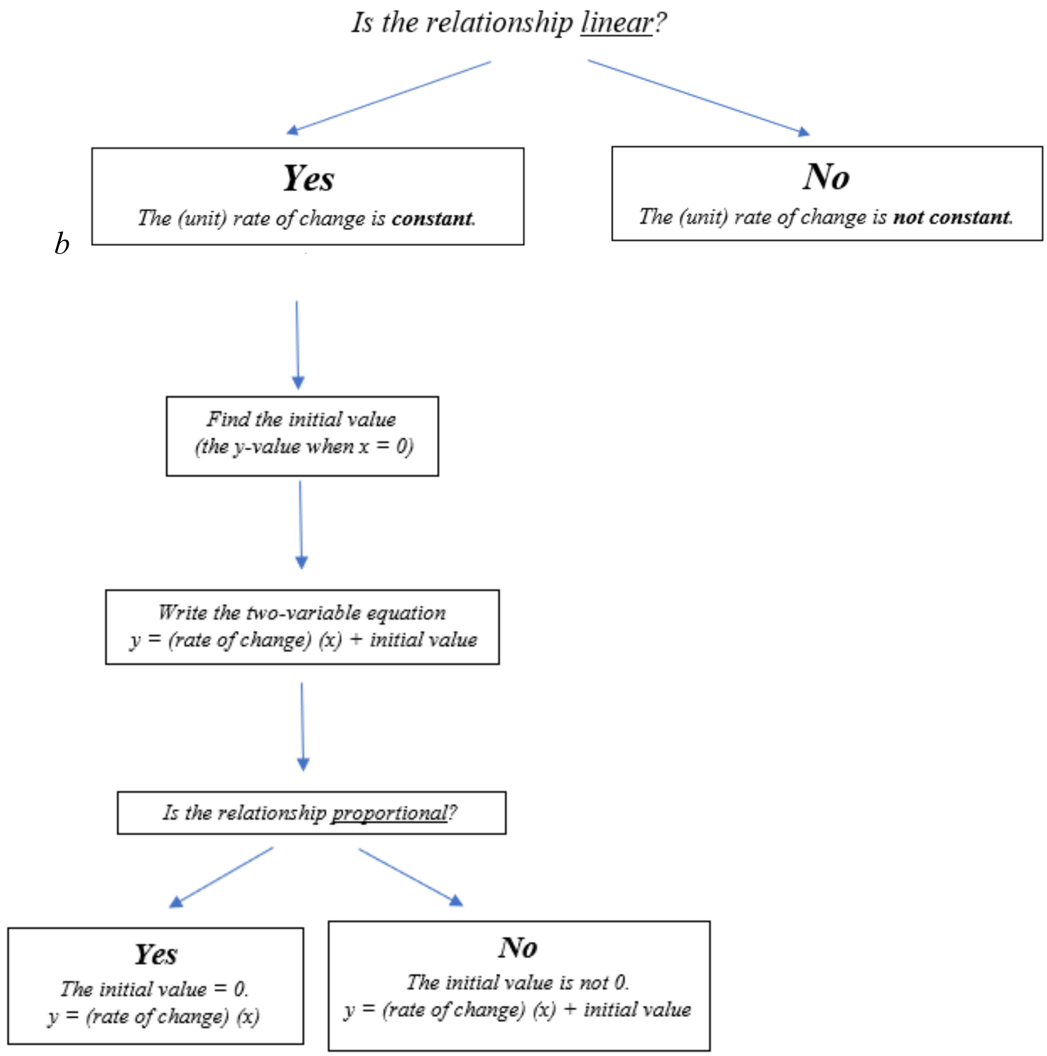
*As part of a *supporting content cluster* of probability and statistics standards, students investigate patterns of association in bivariate data using scatterplots, lines of best fit and two-way tables.

Learning Tasks

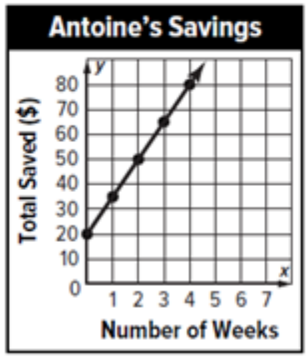
Week One:

- The equations of *proportional relationships* are always in the form $y = mx$, and when graphed produce a line that passes through the origin; in this equation, m is the *slope* of the line, and it is also called the unit rate, the rate of change, or the *constant of proportionality*.

- Determine the rate of change and the initial value of a linear relationship; understand that all proportional relationships are linear relationships, but not all linear relationships are proportional; linear relationships that are not proportional are expressed using the equation $y = mx + b$



Example:



a) Find the rate of change and explain what it means in the context of the problem.

b) Find the initial value and explain what it means in the context of the problem

Week Two:

- Calculate the slope between any two points on a line <u>graphically</u> and <u>algebraically</u> using the slope formula

$$m = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1}$$

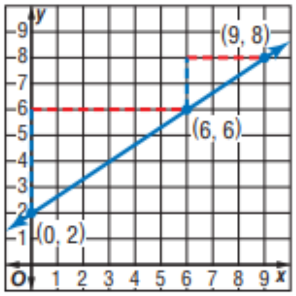
Lines can have a positive or negative slope.

A horizontal line has a slope of 0 because it is "flat."

m = 0

A vertical line's slope is *undefined*.

- Use similar slope triangles to explain why the slope is the same between any two points on a non-vertical line:



The ratio of the vertical side length to the horizontal side length of the larger triangle is 4 to 6, or $\frac{2}{3}$.

The ratio of the vertical side length to the horizontal side length of the smaller triangle is 2 to 3, or $\frac{2}{3}$.

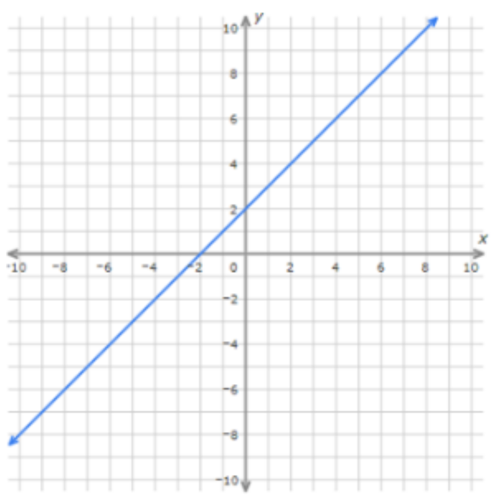
Therefore, the ratio of the rise to run between any two points on this line simplifies to 2 to 3 or ⅔, meaning that the slope of the line is ⅔.

Week Three:

- Derive linear equations: $y = mx$ for a line through the origin and $y = mx + b$ for a line intersecting the vertical axis at *(0, b)*; match linear equations to their graphs

Examples:

1) Write an equation for the linear equation shown in this graph.



2) Write the linear equation for the data in this table.

x	y
2	34
3	48
4	62
5	76

3) Randy wants to buy a membership to Joe's Sports Park. There are different options available, depending on the number of people included on the membership.

Number of People (x)	*Total Cost ($) (y)*
1	*15*
2	*20*
3	*25*
4	*30*

a) Find the constant rate of change (cost per person).

b) Find the membership fee (initial value).

c) Is the relationship proportional? Explain.

d) Write the two-variable equation that represents the data.

- Graph sets of ordered pairs as solutions to linear equations; find ordered pair solutions to linear equations.

Examples:

1) Complete the table and graph the function.

$y = x - 11$	
x	y
1	
2	
6	
8	
9	

2) Choose all ordered pairs that are solutions to the equation y = -2x -5.

A) (3, -1)

B) (-1, 3)

C) (1, -7)

D) (-5, 5)

Week Four:

- Expressed linear functions as tables, equations, and graphs; compare linear functions.

Examples:

1) The cost of using a computer at an internet cafe includes a flat fee plus a rate per minute of use as shown by the table. Determine whether each statement is true or false.

Time (min), x	1	5	10	15
Total Cost ($), y	2.20	3	4	5

a) *The flat fee for internet use is $2.00.*
b) *The cost increases at a rate of $0.50 for every one minute the computer is used.*
c) *The cost for using a computer for 45 minutes is $9.00.*
d) *The cost for using a computer for 55 minutes is $13.00.*

2) Which statement below is true about Functions A and B?

Function A and Function B are linear functions.

Function A

$y = 4x - 2$

Function B

x	y
−6	−17
3	10
8	25

The slope of Function A is greater than the slope of Function B.

The slope of Function A is less than the slope of Function B.

Week Five:

- Understand function rules and input/outputs; recognize function notation; identify examples of non-linear functions.

Examples:

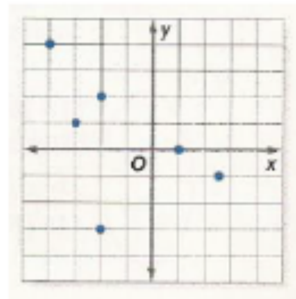
1) Describe why the relation is a function.

$$\{(0,5),(2,7),(6,10),(8,13),(10,16)\}$$

2) Choose all relationships that are functions. Explain why the ones you did not choose are not functions.

A) $\{(1,4),(2,7),(3,10),(4,13),(5,16)\}$

C)



B) $\{(3,8),(5,5),(3,9),(6,7),(8,12)\}$

D) $y = 3x - 2$

3) Apply the function rule given below.

If $f(x) = 4x - 5$, find:

1) $f(4)$ 2) $f(1)$ 3) $f(-2)$

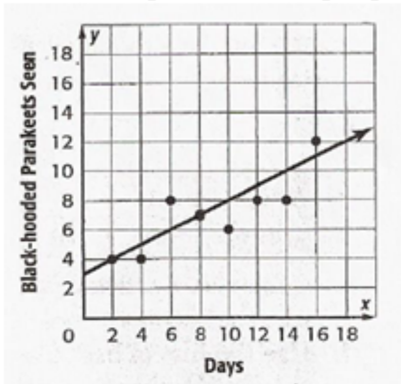
Week Six:

- Construct and interpret scatter plots; describe patterns and associations between variables; draw a line of best fit; write and use the equation of a linear model.

Example:

1) Sage belongs to a bird-watching club. Every two days, she goes out and counts the number of black-hooded parakeets she sees. The scatter plot shows the number of parakeets she saw in the last 16 days.

Bird Watching Club Parakeet Sightings



a) What type of correlation is shown by the data in the scatter plot? Write a sentence to describe the relationship between the variables in this situation.

b) Name the y-intercept of the line of best fit .

c) Choose two data points on the line of best fit and calculate the slope.

d) Write the equation for the line of best fit.

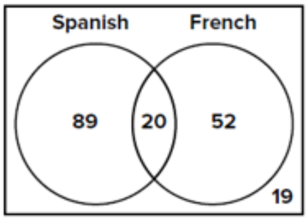
e) Use your equation to estimate the number of parakeets Sage will see on the 24th day.

Week Seven:

- Understand patterns of association in data; display frequencies and relative frequencies; interpret a two-way table.

Examples:

1) Complete the two-way table based on the Venn diagram.



	Spanish	Not Spanish	Total
French			
Not French			
Total			

2) Luca invites 48 friends, including 20 boys, to a party. There were a total of 32 guests who were on time, and of those, 18 were girls.

Part A: Complete the two-way table to summarize the data.

	On Time	Late	Total
Boys			
Girls			
Total			

Part B: Select each valid conclusion using the table in Part A.

- ☐ There are 4 more girls who are on time than boys.
- ☐ The number of boys who are late is half the number of girls who are late.
- ☐ There are 6 guests who are boys and are late.
- ☐ To find the total number of late guests, subtract 32 from 48.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when applicable:

- Quizzes
- Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 6: Systems of Equations
Pacing	Four weeks

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

8.EE.8. Analyze and solve pairs of simultaneous linear equations.

a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs because points of intersection satisfy both equations simultaneously.

b. Solve systems of two linear equations in two variables algebraically (using substitution and elimination strategies), and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.

Supporting Standard:

c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Understand that a solution to a system is the intersection of the graphs of the related linear equations and demonstrate that the point of intersection satisfies both equations.	*Students will know/understand:* ● Solutions to systems of equations ● Graphing using Slope-Intercept Form ● Standard Form ● Substitution ● Elimination
● Solve simple cases shown graphically or algebraically (one solution, no solution, infinite number of solutions) by inspection.	● Types of solutions to systems of equations ● Graphing using Slope-Intercept Form
● Solve systems graphically.	● Graphs of Linear Equations
● Solve systems algebraically using: ➢ Data tables ➢ Substitution ➢ Elimination (through addition or subtraction or multiplication by a factor of negative one)	● Solutions to systems of equations ● Slope-Intercept Form ● Standard Form ● Substitution ● Elimination
● Model real-world situations using systems of equations. *Given a system, create a real-world situation- <u>contextualize</u>.* *Given a real-world situation, create and solve a system- <u>decontextualize</u>*	● Systems of Equations ● Solving Systems graphically and algebraically

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*

1. What types of solutions can systems of linear equations produce?	1. Systems of linear equations may have one solution, infinitely many solutions, or no solution.
2. How can systems of linear equations be used to solve problems?	2. Systems of linear equations can be used to model real-life situations where two quantities are changing simultaneously in two different contexts.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

6. Technology operations and concepts:
Students demonstrate a sound understanding of technology concepts, systems, and operations.

- Use of graphing calculator utility permitted for most student work in this unit.

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media:

- Graphing Calculator Utility
- Videos:
  - Is the Ordered Pair a Solution to the System of Linear Equations?
  - Summary of the Three Methods for Solving Systems of Linear Equations

Online Resources/Websites:

- IXL Lessons- Grade 8 Mathematics, Solving Systems of Linear Equations

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- System of Linear Equations- a collection of two (or more) linear equations that has the same set of variables.
- Solution- the ordered pair(s) that makes both equations true at the same time; the point(s) of intersection of the graphs of the linear equations in the system

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standards in this unit are part of a *major content cluster*. Students discover that the solution to a system of linear equations is the point of intersection of their graphs. Students learn how to solve systems of linear equations graphically and algebraically and determine whether a system of equations has one, infinitely many or no solutions. They also translate real-world situations into systems of equations and determine solutions.

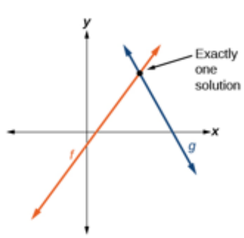
Learning Tasks

Week One:

- Solve systems graphically; understand that a solution to a system is the intersection of the graphs of the related linear equations.
- Demonstrate that the point of intersection satisfies both equations.
- Understand that a system can have one solution, no solution, or an infinite number of solutions.

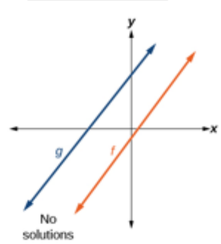
A system of linear equations can have three types of solutions:

One Solution



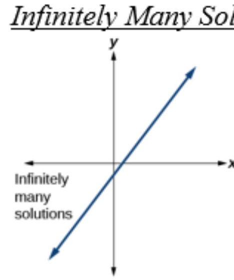
If the lines intersect, the point of intersection is the solution. This is the only ordered pair that will satisfy both equations.

No Solution



If the lines are parallel, (same slope, never intersect) there is no solution. There is no ordered pair that will satisfy both equations.

Infinitely Many Solutions



If the two equations in the system represent the same line (one line graphs on top of the other), every point on the line is a solution. All ordered pairs on the line satisfy both equations.

Terms used to describe a system of equations:

Consistent
(The system has a solution.)

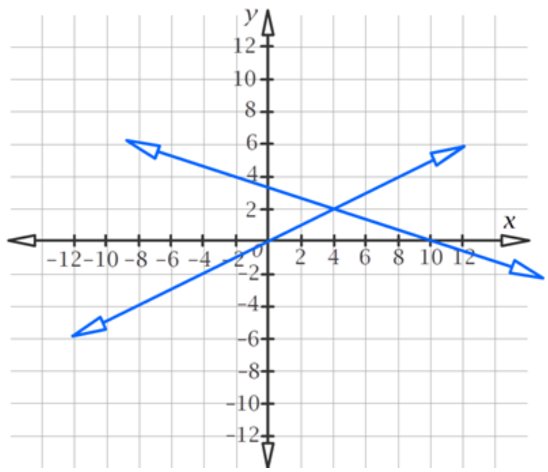
Inconsistent
(The system does not have a solution.)

Independent
(One solution)

Dependent
(Infinitely Many Solutions)

Examples:

1) Write the system of equations shown on the graph below. State the solution.



2) Write numbers in the boxes to create a system of linear equations that has <u>no solution</u>.

$$y = 3(2x+3)$$

$$y = \boxed{\quad}x + \boxed{\quad}$$

3) Write numbers in the boxes to create a system of linear equations that has <u>infinitely many solutions</u>.

$$y = 2(x+4)$$

$$y = \boxed{\quad}x + \boxed{\quad}$$

Week Two:

- Solve systems algebraically using:
  - ➢ Substitution
  - ➢ Elimination (through addition or subtraction or multiplication by a factor of negative one)
- Solve simple cases shown graphically or algebraically.

Examples:

➢ Solve the system of equations using the best method.

1) $y+4x=3$
$y=-2x+9$

2) $2x+3y=-11$
$-8x-5y=9$

Week Three:

- Choose the best method: graphing, substitution, or elimination.
- Model real-world situations and solve problems using systems of equations.

Examples:

1) Sylvia and Raul are computer technicians who make house calls. Sylvia charges a flat fee of \$35.50 plus \$16 per hour. Raul charges a \$15.50 flat fee plus \$20 per hour. Determine whether each statement is true or false. Include the system of equations you used to help you determine your answers.

2)

True	False	
☐	☐	For 2 hours of work, Sylvia charges more than Raul.
☐	☐	For 6 hours of work, Raul charges less than Sylvia.
☐	☐	The equation $35.5x + 16 = 15.5x + 20$ can be solved to find the number of hours for which the total cost is the same to hire either technician.
☐	☐	Both technicians charge the same amount for a 5-hour job.

3) Write a system of equations to model this situation. Be sure to define the variables you are using.

Safety Rent-A-Car rents an intermediate-size car at a daily rate of $21.95 plus $.19 per mile. City Rentals rents an intermediate-size car for $18.95 plus $.21 per mile. For what mileage is the cost the same?

4) Write a system of equations to model this situation. Be sure to define the variables you are using. Use your calculator to solve. Tell how the calculator was useful in helping you reach a solution. Be specific in your explanation.

   Ben has saved only $2.00 this month. He made a deal with his parents to help him save money. They will give him $3.00 per day if he promises to save the money. Joe has a similar agreement with his parents. He has saved $24.00 already, so they agree to give him $2.00 per day if he promises to save the money. Will Ben and Joe ever have the same amount of money on a given day? If so, on what day will that occur? How much money will they have?

Challenge:

Solve.

$$x+y+z=4$$
$$x-2y-z=1$$
$$2x-y+3z=14$$

Challenge: A purse of $100 is to be divided among four men, Albert, Brady, Cam, and David. Brady will have four dollars more than Albert. Cam will have eight dollars more than Brady. David will have twice as much money as Cam. What is each man's share of the money?

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Differentiation
<u>Advanced:</u> Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
<u>Intervention/Re-teaching:</u> Model strategies and provide support through modifications that may include deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when applicable: • Entrance/Exit Slips • Classwork/HW Problems • IXL Skill Practice • Problem Solving Practice
Summative Assessments and Corresponding Rubrics/Checklists when applicable: • Quizzes • Unit Test

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 7: Volume
Pacing	Three weeks

CT Core Standards *What are the goals of this unit?*
Mathematical Practices: *(Practices in **bold** are to be emphasized in the unit.)* **1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. ***Priority/Focus Standard:*** 8.G.9. Know the formulas for the volumes of cones, cylinders, prisms, pyramids, and spheres and use them to solve real-world and mathematical problems.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Investigate the relationship between the volume of cylinders, cones, and	*Students will know/understand:* ● Volume formulas for prisms and cylinders, pyramids, cones, and spheres

spheres	
• Calculate the volume of prisms, cylinders, pyramids, cones, and spheres	• Volume formulas for prisms and cylinders, pyramids, cones, and spheres
• Calculate the volume of composite solids	• Volume formulas for prisms and cylinders, pyramids, cones, and spheres
• Solve problems involving the volume of solids	• Volume formulas for prisms and cylinders, pyramids, cones, and spheres

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are geometric relationships useful?	1. Formulas can be derived for related three-dimensional figures and used to find the volume of solids.

Resources

Student Technology Integration (Correspondence to ISTE Standards when applicable):

4. Critical thinking, problem solving, and decision making:
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

6. Technology operations and concepts:
Students demonstrate a sound understanding of technology concepts, systems, and operations.

- Use of calculator permitted for all student work as calculation is not part of any of the assessed priority standards in this unit; *recommended online calculator: desmos scientific*

Informational Texts

Informational Books:

- Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems)
- Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions)

Media:

- Calculator; *recommended online calculator: desmos scientific.*
- Volume of a Sphere Video:
    - https://www.youtube.com/watch?v=YNutS8eIhEs

Online Resources/Websites:

- IXL Lessons- Grade 8 Mathematics, Volume.

Vocabulary/Terminology

Volume Formulas:

- Prism: $\boxed{V = Bh}$, where B is the area of the base
- Cylinder: $\boxed{V = \pi r^2 h}$
- Pyramid: $\boxed{V = \frac{1}{3}Bh}$, where B is the area of the base
- Cone: $\boxed{V = \frac{1}{3}\pi r^2 h}$
- Sphere: $\boxed{V = \frac{4}{3}\pi r^3}$

Learning Plan

Overview and Key Learning Events and Instruction Per Week

The standard in this unit is part of a *supporting content cluster*. Students investigate the relationship between the volume formulas for cylinders, cones, and spheres. They apply the formulas to calculate the volume of prisms, cylinders, pyramids, cones, and spheres. Finally, students calculate the volume of composite solids and apply the formulas to solve real-world problems involving volume.

Learning Tasks

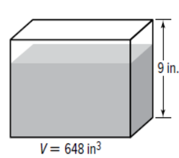
Week One:

- Apply formulas to calculate the volume of prisms and cylinders.

Examples:

1)

Keshia bought an aquarium in the shape of a rectangular prism. The volume of the aquarium is 648 cubic inches and the height is 9 inches. Keshia fills up the aquarium with water so that the water line is 2 inches below the top. Select the appropriate box to indicate whether the answer to each question is yes or no. 7.G.6

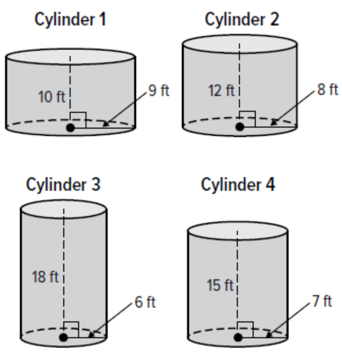


Yes	No	
☐	☐	Could the base of the aquarium be 18 inches long and 4 inches wide?
☐	☐	Could the base of the aquarium be 12 inches long and 8 inches wide?
☐	☐	Could the base of the aquarium be 9 inches long and 8 inches wide?
☐	☐	Is the volume of the water 504 cubic inches?

2)

Four cylinders have the dimensions shown. Complete the table to order the cylinders from least to greatest volume. Round to the nearest tenth. 8.G.9

	Cylinder	Volume (m³)
Least		
Greatest		

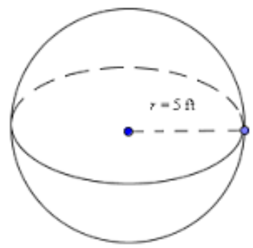


Week Two:

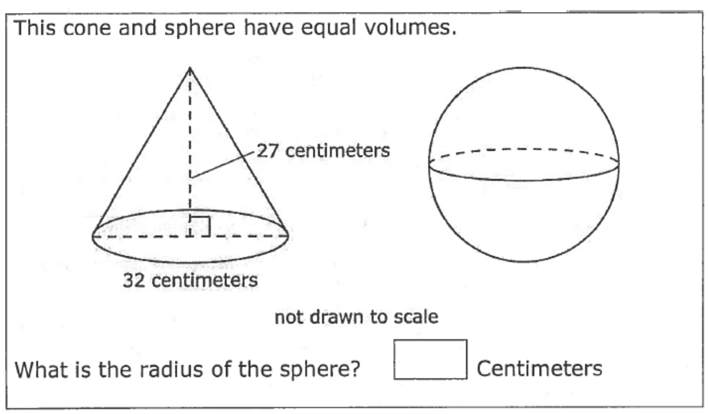
- Understand and apply the formulas to calculate the volume of pyramids, cones, and spheres.

Examples:

1) Calculate the volume of the sphere below.



2)



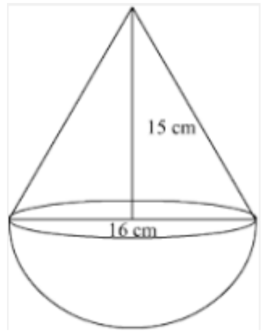
Week Three:

- Calculate volumes of composite solids and solve real-world problems involving volume; use small group pairings of students, small group instruction/re-teaching of strategies, or independent practice.

Examples for Differentiation:

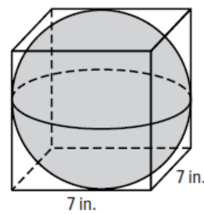
<u>Level 1 Problems (for ***all*** students):</u>

1) Calculate the volume of the composite solid below.



2)

A pet store sells a spherical exercise ball for hamsters. The ball fits in the cube-shaped box, touching the top, bottom, and sides of the box. Write values to complete each statement. Round to the nearest tenth. 8.G.9



The volume of the box is ☐ in^3.

The volume of the exercise ball is approximately ☐ in^3.

The volume of the empty space in the box is approximately ☐ in^3.

Level 2 Reasoning Problems (for ***all*** students):

1)

Alejandro is buying paper cups in the shapes of cylinders and cones. Select whether each shape and size of cup has a volume of at least 200 cubic centimeters. 8.G.9

Yes	No	
☐	☐	cone with diameter 8 cm, height 8 cm
☐	☐	cylinder with diameter 7 cm, height 6 cm
☐	☐	cylinder with diameter 6 cm, height 7 cm

2)

A company sells only items that are in the shape of cubes. Select all of the volumes of cubes with rational number side lengths. 8.NS.1

- ☐ 8 in^3
- ☐ 33 cm^3
- ☐ 1.5 ft^3
- ☐ 9 ft^3
- ☐ $1{,}000 \text{ m}^3$
- ☐ $(4.12 \text{ yd})^3$

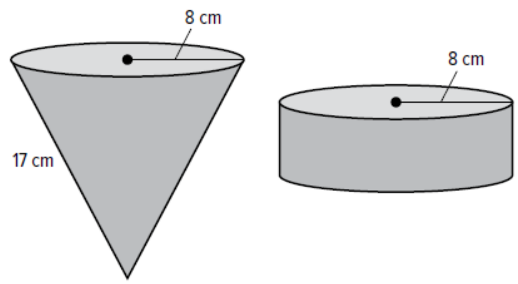
3) A storage cube has a volume of 27 cubic feet. Will the cube fit on a shelf that is 35 inches

below the ceiling? <u>Show your work and explain below</u>.

<u>Level 3 Challenge Problems (for ***accelerated*** learners):</u>

1)

A cone and a cylinder have the same radius, 8 centimeters, and the same volume. The slant height of the cone is 17 centimeters. Select all of the statements that are valid based on the solids. 8.G.7, 8.G.9



☐ The height of the cone is 15 centimeters.

☐ The height of the cylinder is three times the height of the cone.

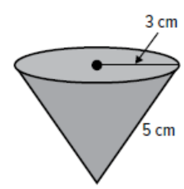
☐ The volume of each solid is 320π cubic centimeters.

☐ The volume of the cone is $\frac{1}{3}$ the volume of the cylinder.

☐ The area of the base of the cone is equal to the area of a base of the cylinder.

2)

A spherical scoop of frozen yogurt is put on top of a cone. Assume the yogurt melts and falls into the cone until the cone is full. Select all of the statements that are true about the frozen snack. Round all answers to the nearest tenth. 8.G.9



☐ The height of the cone is 4 cm.

☐ The cone overflows when a small scoop with a radius of 1.5 cm melts.

☐ A large scoop with a radius of 3 cm melts, and 75.4 cm^3 of yogurt overflows and runs down the side of the cone.

☐ A scoop with a radius of 2.8 cm has the same volume as the cone.

3)

A canned foods company makes two different cylindrical cans, each with the same volume. Can A has a height of 9 centimeters and a radius of 4 centimeters. Can B has a radius of 6 centimeters. What is the height of Can B? Explain how you found your answer. 8.G.9

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

See Problem Solving Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): See "leveled" problem solving Learning Tasks. Provide intervention and extra practice examples so that all students can solve the level one problem independently. Model strategies and provide support with the level two questions.

Enrichment: See "challenge" questions included in the problem-solving Learning. Change the orientation of the figures or include rational and irrational number side lengths to provide a challenge for accelerated learners. Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.

Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding Rubrics/Checklists when applicable:

- Entrance/Exit Slips
- Classwork/HW Problems
- IXL Skill Practice
- Problem Solving Practice

Summative Assessments and Corresponding Rubrics/Checklists when applicable:

- Quizzes
- Unit Test
- Problem Solving Assessment w/rubric (see Unit 2)

Westbrook Public Schools
Middle School
Mathematics Curriculum

Subject(s)	Mathematics
Grade/Course	Grade 8 Math
Unit of Study	Unit 8: Angle Relationships
Pacing	One week

CT Core Standards
What are the goals of this unit?

Mathematical Practices:
*(Practices in **bold** are to be emphasized in the unit.)*

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Priority/Focus Standards:

8.G.5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	***Concepts*** *What must students **know**?*
Students will be able to: ● Determine angle relationships when parallel lines are cut by a	*Students will know/understand:* ● Adjacent Angles ● Supplementary Angles

transversal	• Complementary Angles • Transversal lines • Corresponding Angles • Vertical Angles • Alternate Interior Angles • Alternate Exterior Angles
• Determine the sum of interior angles of a triangle.	• Interior Angles • Triangles
• Determine the sum of the exterior angles of a triangle.	• Exterior Angles • Triangles

Essential Questions *What essential questions will be considered?*	***Corresponding Big Ideas*** *What understandings are desired?*
1. How are geometric relationships useful?	1. Interior and exterior angle measures can be determined by understanding the angle relationships when parallel lines are cut by a transversal.

Resources
Student Technology Integration (Correspondence to ISTE Standards when applicable): 5. Computational Thinker- Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. c) Students will use the principles of computer science to create, debug and solve challenges and problems. Students break problems into component parts, identify key pieces, and use that information to problem solve.
Informational Texts ***Informational Books:*** • Glencoe/McGraw-Hill, Course 3 (for classwork/HW practice problems) • Think Smart for the Smarter Balanced Assessment (for problem solving/reasoning questions) ***Media:*** • Geometry software ***Online Resources/Websites:***

- IXL Lessons- Grade 8 Mathematics, Angle Relationships.

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

- Interior Angles- the angles inside of a triangle; the sum of the interior angles of a triangle is always 180 degrees.
- Exterior Angles- the angles that form a linear pair with the interior angles by extending the sides of a triangle; the sum of the exterior angles of a triangle (and any polygon) is 360 degrees.
- Adjacent Angles- two angles that have a common side and a common vertex, but do not overlap.
- Supplementary Angles- two angles whose sum is 180 degrees.
- Complementary Angles- two angles whose sum is 90 degrees.
- Transversal line- a line that intersects two or more other (often parallel) lines.
- Corresponding Angles- any pair of angles on the same side of one of two lines cut by a transversal and on the same side of the transversal.
- Vertical Angles- each of the pairs of opposite angles formed by intersecting lines.
- Alternate Interior Angles- angles created when a transversal crosses two (usually parallel) lines; each pair of these angles is inside the parallel lines, and on opposite sides of the transversal.
- Alternate Exterior Angles- angles created when a transversal crosses two (usually parallel) lines; each pair of these angles is outside the parallel lines, and on opposite sides of the transversal.

Learning Plan

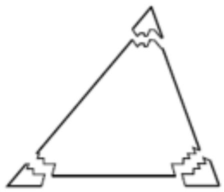
Overview and Key Learning Events and Instruction Per Week

The standard in this unit is part of a *supporting content cluster*. Students use facts about supplementary, complementary, vertical, and adjacent angles to write and solve simple equations for an unknown angle in a figure. They also use their knowledge of solving equations in one variable to calculate missing angle measurements when given an angle measure as an algebraic expression.

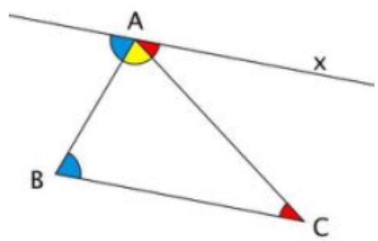
Learning Tasks

- Determine the sum of interior angles of a triangle:

★ Use a model to show that the three angles can be put together to form a line: therefore, the sum totals 180 degrees:



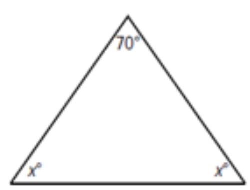
OR



Examples:

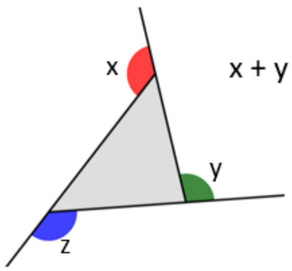
1) A triangular flower bed has the angle measures shown. Write and solve an equation to find the value of x.

2) A triangle has the angle measures shown. Write and solve an equation to find the value of x.

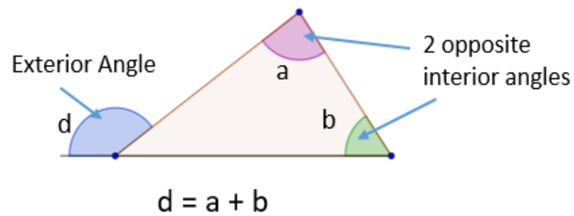


- Determine the sum of the exterior angles of a triangle:

The sum of the exterior angles of a triangle and any polygon is 360°.

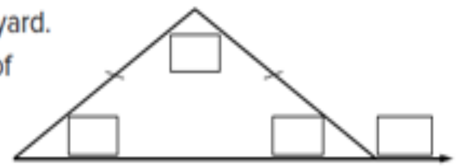


The exterior angle is equal to the sum of the two opposite interior angles.



Example:

Nascha's sons set up a tent for a campout in the backyard. The tent's instruction manual identifies the measures of the angles when the tent is set up correctly. 8.G.5



Part A: Write the appropriate angle measures in the spaces.

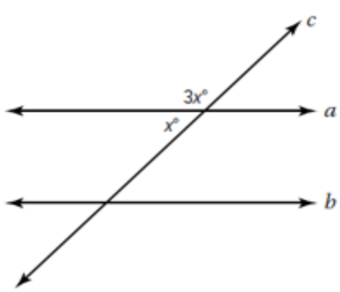
35°	40°	145°	75°	110°	60°	215°

Part B: Justify each measure that you wrote in the triangle.

- Determine angle relationships when parallel lines are cut by a transversal:

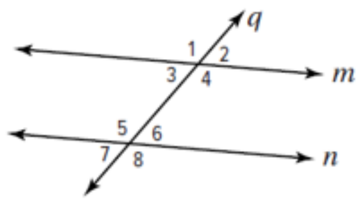
Examples:

1) Lines *a* and *b* are parallel and cut by the transversal *c*. Write and solve an equation to find the value of x. Then find the measure of the eight angles in the diagram.



2)

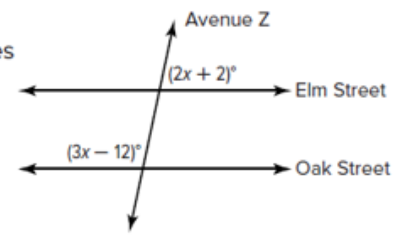
Lines m and n are parallel and cut by the transversal q. Identify each statement as true or false. 8.G.5



True	False	
☐	☐	$\angle 1 \cong \angle 8$
☐	☐	$m\angle 4 = 110°$, so $m\angle 5 = 70°$.
☐	☐	$m\angle 7 = m\angle 3$

3)

Elm Street and Oak Street are parallel. Avenue Z crosses each of them. The city planner needs to find the measures of the angles at each intersection. Find the measures of the labeled angles. 8.G.5



angle between Avenue Z and Elm St.: ☐

angle between Avenue Z and Oak St.: ☐

*There are many instances in our daily life when we can find ***vertical angles*** being formed. For example, the blades of a scissor when opened cross each other and we can observe the vertical angles being formed. Similarly, another real-life example would be when two rail tracks cross each other and they form vertical angles.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☐ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
See Learning Tasks.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Model strategies and provide support through modifications that may include: deceleration, flexible pacing, or restructuring of learning activities. Students still struggling will be provided additional instruction and practice through one-on-one or small group re-teaching.
Enrichment: Provide questions that require a higher level of response and open-ended questions that encourage students to think in a more abstract and complex manner.
Learner Support: Aperture is used to survey the social-emotional needs of all WMS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding Rubrics/Checklists when applicable: • Classwork/HW Problems • IXL Skill Practice
Summative Assessments and Corresponding Rubrics/Checklists when applicable: • Quiz

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades: 10th and 11th / Honors/College Prep Chemistry
Unit of Study	Unit 1: The Structure of Matter and the Periodic Table
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:

Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction,

reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed)

with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation, and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to create models of atoms correctly identifying the numbers and location of protons, neutrons, and electrons in the atom. 2. Students must be able to write an electron configuration of an element. 3. Students must be able to determine the number of valence electrons of an element in any of the eight main groups of the periodic table (groups 1, 2, 13, 14, 15, 16, 17 18)	1. The periodic table of elements organizes all elements based on the number of protons in the nucleus, and an equal number of electrons. The atomic weight of an element also allows the calculation of the number of neutrons on the nucleus. There can exist atoms of an element with different atomic weight due to differing numbers of neutrons. The multiple atoms with differing atomic weight are referred to as isotopes. 2. Electrons are arranged around the nucleus of an atom based on energy levels that the electrons occupy. These energy levels, numbered 1 through 7, and their sequence are known as an electron configuration. 3. Energy levels that electrons occupy may contain up to four sublevels (spaces that have the greatest probability of finding an electron) known as s, p, d, and f orbitals. Valence electrons are the electrons that occupy the s and p orbitals at the highest energy level in an atom.

4. Students must be able to identify some of the properties of an atom of an element using their location on the periodic table.	4. The periodic table arranges elements based on being metals, nonmetals, and metalloids. There are also trends in specific properties of elements on the periodic table. These properties include electronegativity, atomic radius, and ionization energy, among others.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can one explain the structure and properties of matter? 2. How is the Periodic Table of Elements organized and arranged according to properties of the elements?	1. Matter is composed of extremely small particles called atoms and these atoms are composed of subatomic particles, positively charged protons, neutrally charged neutrons, and negatively charged electrons. The protons and neutrons are found in a very small, dense cluster in the center of the atom called the nucleus. Protons and neutrons have approximately the same m while electrons have mass of approximately 1/1800th of a proton. The identification of the atoms is based on the number of protons, its properties are determined by the electrons and neutrons and protons contribute almost 100% to the mass of an atom.

Resources
Student Technology Integration and Correspondence to ISTE Standards: ● 1.1 Empowered Learner ● Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning science. ● 1.2 Digital Citizen

Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical**.**

- 1.5 Computational Thinker
  Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson.
- *Modern Chemistry* by Raymond E. Davis.
- *Problem Solving for Chemistry* Edward I. Peters

Online Resources / Websites:

- Khan Academy - Introduction to electron configurations.
  - https://www.astronomy.ohio-state.edu/pogge.1/TeachRes/HandSpec/atoms.html emission spectra of visible light of chemicals

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. amu - atomic mass unit.

2. atom - the smallest identifiable particle of an element.

3. accuracy - how close a measurement or calculation is to the actual answer.

4. precision - how close multiple measurements or the same calculations are compared to the actual answer.

5. proton - a subatomic particle having a positive electrical charge and found in the nucleus of an atom.

6. neutron - a subatomic particle with a neutral electrical charge found in the nucleus of an atom.

7. electron - a subatomic particle arranged in energy levels around the nucleus of an atom.

8. periodicity - repeating patterns and trends of properties of elements on the periodic table.

9. family - a vertical column of elements on the periodic table.

10. group - the same as a family on a periodic table.

11. main groups - columns 1, 2, 13, 14, 15, 16, 17, 18 (alternative Roman Numerals I through VIII) on the periodic table.

12. alkali metals - group number 1 on the periodic table (except for hydrogen).

13. alkali earth metals - group number 2 on the periodic table.

14. transition elements - groups 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 of the periodic table.

15. noble gasses - group 18 on the periodic table.

16. metalloids - the following elements compose the region on the periodic table known as the metalloids: antimony (Sb), germanium (Ge), silicon (Si), arsenic (As), tellurium (Te), polonium (Po), boron (B), and astatine (At). These elements align as a diagonal, staircase shaped, group extending from Boron to Polonium on the periodic table.

17. series - a horizontal row of elements on the periodic table. There are seven rows on the main part of the periodic table.

18. period - the same as a series on the periodic table.

19. energy levels - a scheme of how electrons arranged around the nucleus of an atom based on energy.

20. orbital - a three-dimensional space in an energy level that contains electrons.

21. suborbital - a three-dimensional subdivision of an orbital with greatest probability of containing an electron.

22. isotope - multiple forms of atoms of the same element that differ in the number of neutrons therefore also differ in mass.

23. electron configuration - an alphanumeric sequence of the energy levels and orbitals for electrons in an atom.

24. average atomic mass - a calculation of the atomic mass of an element based on the percentage of each isotope of the element.

25. s orbital - a single spherical space capable of containing a maximum of two electrons.

26. p orbital - a three dimensional space composed of three sub orbitals. Each sub orbital can contain a maximum of two electrons for a total of up to six electrons in the entire orbital.

27. d orbital - a three-dimensional space composed of five sub orbitals. Each sub orbital can contain a maximum of two electrons for up to a total ten electrons in the entire orbital.

28. f orbital - a three-dimensional space composed of seven sub orbitals. Each sub orbital can contain a maximum of two electrons for up to a total 14 electrons in the entire orbital.

29. lanthanide series - consists of elements with atomic numbers 57 to 71 on the periodic table. This row of elements is most located beneath the main body of the periodic table. The lanthanides are a part of series number 6.

30. actinide series - consists of elements with atomic numbers 89 to 103 on the periodic table. This row of elements is most located beneath the main body of the periodic table, below the lanthanide series. The actinides are a part of series number 7.

31. ground state - the lowest energy level that an electron can occupy in an atom.

32. excited state - an energy level in an atom that an electron can jump up to after gaining an amount of energy.

33. electronegativity - a relative measure of the ability of an atom to attract and hold onto electrons.

34. ionization energy - the amount of energy required to remove an electron from an atom,

35. atomic radius - the distance from the center of an atom’s nucleus to an outermost electron in the energy levels surrounding

the nucleus.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: Explanation of course outline and expectations, lab safety and pointing out safety devices in lab, followed by Lab Safety reading assignment. Quiz on safety will take place in the next class session. Students must score 85% or higher to perform lab experiments. Quizzes will be kept on file documenting student awareness of lab safety devices and procedures. A review of qualitative and quantitative observations followed by an activity "Observations of a Burning Candle". This activity will require students to classify their observations as qualitative or quantitative and write a chronological essay of all their observations. Students will self-evaluate their essays by comparing it to a professional scientist's similar essay, with class discussion.

Week 2: A review of the metric system of the units of mass, length, and volume employing a graphic representation of the subdivisions of the base units of metric measurement. Practice problems of metric conversions of base units to subdivisions will take place in class followed by a formative "open note" formative quiz on metric conversions of subunits. A reference sheet of conversions from metric to other systems of measurement (inches, feet, miles, ounces, pounds, pints, and quarts, and gallons etc. will be distributed and reviewed, the reference sheet is to be kept by the students. The "factor label "aka "dimensional analysis' ' method of problem solving will be introduced by making conversion of metric units into subunits and converting metric units of measurement into other systems of measurement or vice versa. A notes outline will be distributed with demonstration and practice problems for this lesson. Rules for determining "significant figures "and rounding off will be distributed as a reference sheet, reviewed, and include practice problems to be done in class and discussed. The week will end with an activity where students will differentiate between accuracy and precision in experiments and how these two properties relate to each other.

Week 3: A summative assessment on the topics covered in the first two weeks will take place at the beginning of Week Three. As an opening exercise, Students will be given a pre quiz on the Periodic Table of Elements. This quiz will be repeated several times as the class explores the periodic table in this unit. A lecture covering the structure of an atom will take place. Following the lecture, students will be tasked with drawing a color-coded model of an atom of an element depicting its structure. The models will be displayed on the whiteboard for students to do a gallery walk followed by class discussion about the models. A basic periodic table will be distributed to students and the information included in the squares for each element will be reviewed. A lecture will take place discussing isotopes and calculation of average atomic mass, followed by classroom practice problems and an assignment

of problems as homework. Assigned homework will be reviewed in the next class. Following this review, a formative assessment will take place of problems about isotopes and calculating average atomic mass. Corrected summative assessment will be returned and reviewed at the end of the week.
Week 4: The week begins with a simple discussion of the traditional model of the arrangement of electrons around the nucleus of an atom (like the solar system). The "Light Saber" demonstration is then done as a phenomenon to introduce the quantum model of arrangement of electrons around the nucleus. Students will receive a packet that leads them through models of the energy level (quantum) model of the arrangement of electrons. The packet progresses from just energy levels, orbitals, sub orbitals, overlapping energy levels and the process of locating electrons in the correct sequence on this model. Students are guided through the process of placing electrons of several different elements of the main groups on this model. They are then instructed to place the electrons of each element in series 2 of the periodic table on a separate copy of the model. The quantum model is then used to derive the alphanumeric electron configuration of an atom's electrons. Practice writing electron configurations for a selection of elements from the periodic table and a corresponding assignment for homework. The week will end with the class engaging in an" Electron Configuration Challenge". The goal of the challenge is to write an accurate and complete electron configuration, from memory only, faster than the teacher. Pending results of the challenge, students could receive a bonus (formative assessment) quiz grade up to 100 points. Students will perform a "Flame Test" experiment to observe the emission spectrum of four metal salt solutions and identify the metal ions in solution from the spectrum. The experiment may overlap slightly into the next week.
Week 5: This week will focus on the regions of the periodic table, names and numbering of families, numbering of series, and trends of the properties of electronegativity, ionization energy and atomic radius on the periodic table. Given a blank periodic table. students will be given the names of the regions of the periodic table and create a color-coded model of them on the blank periodic table. They will also be given the names of several families in the main groups of the periodic table and indicate them by their names. In addition to the above, the students will be given data tables and graphs of the three properties listed above. They must analyze the data and graphs, identify the general trends of these properties in both series and groups on a second blank periodic table. When completed, the completed period tables will be posted on a whiteboard and students will view them and compare them. to be given at the beginning of week six.
Week 6: A test outline of the unit test will be distributed, and a comprehensive review of the unit will take place for the unit summative assessment. The summative assessment of this unit will take place this week. The corrected exams will be returned and reviewed before starting Unit 2.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
• Students will be applying math skills (critical thinking) in problem solving and use communication skills taught in other subject areas, such as ELA.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, in Unit 1, students in Honors Chemistry will be instructed in calculating energy level values. Energy will be gained and lost when an electron in an atom of hydrogen jumps from ground state to an excited state and returns to ground state. Using this information, students will also be able to determine the wavelength of light energy emitted when it returns to ground state, using the energy difference between ground and excited states utilizing a set of light equations calculations.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Name____ Date_____________________ Period

Electron Configuration Formative Quiz

1, Write a full electron configuration for each of the elements below:

a. ${}_{2}^{4}He$

b. ${}_{8}^{16}O$

c. ${}_{17}^{35}Cl$

d. ${}_{26}^{56}Fe$

e. ${}_{36}^{54}Ar$

f. $_{58}^{140}Ce$

2. How many valence electrons are in each of the elements in question 1?

a.

b,

c.

d.

e.

f.

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Name: ____ Total points: 201 points

Atomic Structure Unit Test. Solve all problems that follow. Don't forget to label answers with appropriate units.

1. Summarize J.J Thomson's and Ernest Ruthurford's contributions to our understanding of the structure to an atom. 10 points

2. Determine the number of protons, neutrons, and electrons in each element below 2 points each (10 total points

element	protons	neutrons	electrons
${}_{16}^{32}S$			
${}_{20}^{40}Ca$			
${}_{79}^{197}Au$			
${}_{86}^{222}Rn$			
${}_{90}^{232}Th$			

3. A. Calculate the average atomic mass in amu's of the three isotopes of Argon using the data below.

15 points

Isotope	mass	abundance
^{36}Ar	35.97 amu	0.337%
^{38}Ar	37.96 amu	0.0630%
^{40}Ar	39.96 amu	99.60%

B. Calculate the average atomic mass in amu's of the four isotopes of lead using the data below.

20 points

Isotope	mass	abundance
^{204}Pb	203.97 amu	1.40%
^{206}Pb	205.97 amu	24.01%
^{207}Pb	206.98 amu	22.10%

^{208}Pb	207.98 amu	52.40%

4.Write a full electron configuration for the following elements.

20 points (5 points each)

a. F

b. Ni

c. Rb

d. Eu

5.Write an abbreviated electron configuration for the following elements

20 points (5 points each)

a. C

b. V

c. Po

d. U

6. Calculate the energy of the following energy levels.

10 points (5 points each)

a. n=3

b. n=7

7. Calculate the wavelength of light emitted when an electron in the Lyman Series transitions from an excited energy level of n=6 to ground state. Also, is the light visible?

20 points

8. Calculate the wavelength of a light emitted when an electron in the Balmer Series transitions from an excited energy level of n=4 to ground state. Also, is this light visible?

20 points

9. a. What are the four quantum numbers for an electron in the 5 P_z sub-orbital with counterclockwise spin

8 points (2 points each

b. What are the four quantum numbers for an electron in the 7 S orbital with clockwise spin

8 points (2 points each)

c. What are the four quantum numbers for an electron in the $5f^9$ suborbital with counterclockwise spin?

8 points (2 points each)

d. What are the four quantum numbers for an electron in the 4 d $(x^2 - y^2)$ sub-orbital with counterclockwise spin?

8 points (2 points each)

10. Write a description of an electron with the four quantum numbers: 8 points each for parts a, b, and c (total 24)

a. 2, 1, 0, +1/2

b. 6, 3, +2, -1/2

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11, Honors / College Prep Chemistry
Unit of Study	Unit 2: Chemical Bonding and Reactions
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

8. Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a

problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection.

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:
HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS-1- 2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties**.**

HS-PS-1-3 Plan and investigate to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS 2- 6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students will be able to describe and draw a model of an ionic bond, covalent/polar covalent bond and metallic bond.	1. Bond formation between nonmetal atoms is dependent upon the difference in the property of electronegativity (the ability of an atom to attract and hold onto another atom). Specifically, students will calculate the difference in electronegativities of the two bonding nonmetal atoms and the magnitude of the difference will determine the type of bond that forms. Very low differences favor covalent bonding while large differences will cause ionic bonds. Metallic bonds are essentially the nuclei of metal atoms "floating in a sea" of electrons.
2. Students will be able to draw a Lewis Structure model of	2. A Lewis Structure model requires following a number of

a molecule or polyatomic ion composed of two or more atoms from the eight main groups of the periodic table.	steps that include knowing how to determine the total number of valence electrons of the atoms in the molecule and arrange the total number of valence electrons of the atoms in the molecules such that each atom is surrounded by a number of valence electrons that is the same as one of the Noble Gas elements (main group number 18 on the periodic table) commonly referred to as a complete octet.
3. Students will be able to identify a type of chemical reaction from a balanced equation representing the reaction amd predict the chemical formulas of products in chemical reactions.	3. There are six basic types of chemical reactions. They include: (a) synthesis, (b) decomposition, (c) single displacement, (d) double displacement, (e) combustion, (f) acid/base.
4. Students will be able to balance a chemical equation such that there are equal numbers of each atom in the reactants and products of the reaction.	4. The Law of Conservation of mass and atoms states that matter cannot be gained or lost during a chemical reaction.
5. Students will be able to construct two- or three-dimensional models of molecules and identify their geometric shape.	5. The geometry of molecules is determined by the repulsion of the individual bonds between the atoms composing the molecule.
6. Students will be able to explain why molecules have different geometric shapes using the VSEPR Theory	6. The **VSEPR** Theory (**V**alence **S**hell **E**lectron **P**air **R**epulsion) is a model used to predict the molecular geometry of a molecule or polyatomic ion based on the number of valence shell electron bonded pairs between the atoms of the molecule or polyatomic ion. This model assumes that electron pairs will arrange themselves to minimize or equalize repulsion between the bonded pairs of electrons.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why do most atoms form chemical bonds?	1. Most chemical bonds form by either transferring or sharing electrons between atoms.
2. How are ionic and covalent bonds formed and how does the bond type influence the properties of compounds?	2. Ionic bonds occur when electrons are transferred from one atom to another creating positive and negative ions that attract each other while covalent bonds form when a pair of electrons are shared between two atoms and attracted equally to the two atoms.
3. What is the format for representing a chemical reaction with a chemical equation?	3. A chemical equation is formatted such that the reacting chemicals are on the left side of an arrow which points to the right to the chemical products of the reaction.
4. How is the Law of Conservation used to balance chemical equations?	4. The Law of Conservation states that during a chemical reaction, matter can neither be created nor destroyed. The number of each atom in reactants must equal the number of atoms in the products.
5. What factors determine the geometric shape of a molecule?	5. The main factor influencing molecular geometry is the balance of repulsive forces of bonds between atoms that compose the molecule.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Informational Texts and/or Media: • *Chemistry: Principles and Reactions* by Hurley and Masterson • *Modern Chemistry* by Raymond E. Davis • *Problem Solving for Chemistry* Edward I. Peters **Online Resources / Websites:** • Google Slideshow - Chemical Bonding

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. ionic bond - a force of attraction caused by the transfer of one or more electrons from one atom to another creating a positively charged ion and a negatively charged ion which are strongly attracted to each other.

2. covalent bond - a force of attraction between two atoms created by a pair of electrons that are shared between the nuclei of the two atoms.

3. metallic bond - the nuclei of metal atoms are essentially immersed in and surrounded by mobile electrons.

4. ion - an electrically charged atom or group of atoms.

5. monatomic ion - an electrically charged particle composed of only one atom.

6. polyatomic ion - an electrically charged particle that is composed of two more atoms.

7. cation - a positively charged ion.

8. anion - a negatively charged ion.

9. reactants - Molecules or atoms that are interacting with each other and form new chemical bonds rearranging atoms to produce chemical changes and new chemical structures.

10. products - new chemical structures caused by formation of new chemical bonds and rearrangement of atoms in the reactants of a chemical reaction.

11. Law of Conservation - matter cannot be created or destroyed during a chemical reaction.

12. balanced chemical equation - a chemical equation where the number of atoms in the reactants is equal to the number of atoms in the products of the reaction.

13. Law of Multiple Proportions - This law states that the same atoms can bond in different whole number ratios to form molecules with different whole number ratios of each atom and different physical and chemical properties.

14. Lewis Structure - a model of a molecule or polyatomic ion based on the number of valence electrons of all the atoms. The electrons are arranged around the symbols of the atoms in the molecule or polyatomic ion to be the same arrangement of the electrons in a Noble Gas element known as a complete octet except for hydrogen having only two electrons.

15. metal salt - an ionic compound composed of metal and nonmetal ions.

16. solvent - a substance that will dissolve another substance.

17. solute - a substance that is dissolved in a solute.

18. solubility - a measure of how much of a compound will dissolve in a solvent.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: This week will include a slideshow that focuses on the role of electrons in forming chemical bonds and describing how to identify the different types of chemical bonds. Students will be given notes outline to accompany the slideshow presentation. As part of the presentation, students will be instructed to draw models of the three basic types of chemical bonds based on a verbal description. As the week continues, the slide show focuses on what Lewis Structures are and how to draw them. A student handout will be distributed listing summarized steps for drawing the structures. Several examples of molecules and polyatomic ions are included on the handout and will be done as demonstration samples of creating these structures. Students will then work on practicing Lewis Structure problems. The problems will then be reviewed and a short formative quiz consisting of several problems will be given. Students will be allowed to use the Lewis Structure handout during this quiz. The week will end with a note's session describing the six basic types of chemical reaction and how to recognize them. This will be followed by an assignment where students will have to identify the type of reaction a number of balanced chemical equations are. The assignment will be reviewed in the next class meeting.

Week 2: After reviewing the type of reaction assignment, Students will then perform a lab experiment designed to prove the law is the Law of Conservation. (This experiment will take approximately two class periods to complete). A lab report outline will be distributed, and students will be assigned to write a formal lab report after completing the experiment using the format in the outline.
Week 3: The focus of week three will be on balancing chemical equations. The concept of this is satisfying the Law of Conservation A lecture will be given (accompanied by a notes outline) that discusses the Law of Conservation in chemical reactions and demonstrates a variety of strategies for balancing chemical equations. The outline also includes a variety of chemical equations that employ different strategies to complete the balancing of atoms in reactants and products. A practice sheet will be distributed for students to work on balancing a variety of equations in class with the teacher circulating and assisting students as they work on the equations. An assignment of equations to balance will be given and reviewed in the next class. Following the review of the balancing equations assignment, a formative quiz on balancing equations and identifying types of reactions will be given, corrected, and returned in class, and reviewed. As needed, remedial discussion and review on this topic will take place. Students will then perform a lab experiment where they predict the products of reactions between solutions of different metallic salts. They will also have to write balanced equations of the reactions that take place. A discussion of the concept of solubility of chemicals in water will precede this lab.
Week 4: Week four will engage the students in the study of molecular geometry. Working in groups of two or three students, students will construct 2 or 3 dimensional models of ten different models of geometric shapes of molecules using cardstock paper, glue, and scotch tape. For this activity, students will be supplied with cardstock, tape, and glue. They will also be provided with templates to make three- and four-sided pyramids as needed for several models. The students will be using line drawings of the 16 geometric models (10 for college prep chemistry) as a guide in constructing the models. This includes the shapes, general formulas, and bond angles. This project will require two full class periods to complete all models. As students work on the projects, the teacher will circulate to answer questions and make suggestions for construction of the models. Students will be responsible for identifying the geometric shapes, the generic formula (central atom, peripheral atoms attached to the central atom, unshared pairs of electrons and bond angles. Following completion of the paper models, students will compare their models to ball and stick models and make any modifications as needed to their models. A display of a set of previously prepared paper models and ball and stick matched up models will be prepared for students to photograph and use for study.
Week 5: One period of week five will be spent reviewing all of the 16 models and allowing students to photograph each of their models next to the corresponding ball and stick models for the purpose of study for a summative assessment on molecular geometry. Review will also take place during this period. The summative assessment on molecular geometry will be an oral exam given to each pair or group of three students where they will be asked 10 to 16 (10 for College Prep) questions posed to members of the group in a rotating sequence. During the assessment, students will be using their constructed models and the ball and stick models

to answer specific questions.
Week 6: A two class period comprehensive review packet of all content in the unit, based on a test outline that excludes molecular geometry, will be distributed to students. Over two class periods, a review of the packet will take place allowing students to ask clarifying questions and work on sample problems like questions that will appear on the unit test. The last period of the week is the scheduled day for the unit test to be given.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

- Students will be applying math skills (critical thinking) in problem solving and use communication skills taught in other subject areas, such as ELA.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, Students in Honors Chemistry will be expected to construct and identify many more molecular geometric shapes than College Prep Chemistry students.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Name_______________________________________ Date_________ Period________ Chemistry

Chemical Reactions Formative Quiz **Total Point Value = 39 points**

1. Identify the type of reaction each of the following reactions (4 points each)
   a. $2C_2H_4 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

   b. $Fe(NO_3)_3 + AlCl_3 \rightarrow Al(NO_3)_3 + FeCl_3$

   c. $H_2 + Cl_2 \rightarrow 2HCl$

   c. $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$

d. $MgBr_2 + Cl_2 \rightarrow MgCl_2 + Br_2$

e. $2H_3PO_4 \rightarrow 3\ H_2 + 2\ P + 4\ O_2$

2. Balance the following chemical reactions (5 points each)

a. $Cs + N_2 \rightarrow Cs_3N$

b. $K + B_2O_3 \rightarrow K_2O + B$

c. $Rb + RbNO_3 \rightarrow Rb_2O + N_2$

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Molecular Geometry Test

Oral/Practical Test

Names of students in the group

____

____

____

Directions: Students will be given two tries to answer a question with no penalty for an incorrect first response.

When asked to refer to a constructed or ball and stick model, students may not receive assistance from group members or the teacher in choosing the model.

The following 12 or 16 questions will be asked: (12 for CP Chemistry and 16 for Honors Chemistry)

1. Using models, the group constructed, identify a linear molecule.
2. Using models the group constructed, identify a tetrahedral molecule.
3. What is the generic formula of a trigonal planar molecule? You may refer to your constructed models or ball and stick models.
4. Using the ball and stick models, identify a trigonal bipyramidal molecule.
5. What is the generic formula of a trigonal bipyramid?
6. Using the ball and stick models, identify the octahedral molecule.
7. Match the group's constructed square planar molecule with the corresponding ball and stick model.
8. What is the generic formula of the square planar molecule? You may refer to the ball and stick models.
9. How many unshared pairs of electrons are found in a 3 dimensional bent or angular molecule?
10. What is the generic formula for an octahedral molecule. You may refer to your constructed models of the ball and stick models.
11. Using your constructed molecules, identify the trigonal pyramid.
12. What the bond angles in a trigonal planar molecule. You may refer to your constructed models.
13. Point out all the bond angles in a trigonal bipyramidal molecule. You may refer to a ball and stick model.
14. What is the generic formula for a square pyramidal molecule? You may refer to your constructed.
    model.
15. What are the bond angles in a tetrahedral molecule? You may refer to your constructed model.
16. What is the generic formula for a T-shaped molecule? You may refer to your constructed model.

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 3: Mole Concept and Stoichiometry
Pacing	6 Weeks

CT State Standards

What are the goals of this unit?

Priority/Focus Standards:

Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction,

reaction force, energy).

6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

8. Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection.

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-7

Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

[Correspondence to CT Core Standards]

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze or accurately interpret information.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Speaking and Listening: Students will be able to present solved chemistry problems with clarity and confidence. Their presentation must include all needed formulas, show all steps in the calculations, with accurate descriptions and be able to answer questions from the class audience.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must understand and apply the basic definitions of a mole and apply these definitions to solve a variety of mole calculations such as moles to grams, grams to moles, moles to particles, particles to moles. (Particles refer to atoms of molecules) Volume of a gas at STP to moles, moles to the volume of a gas at STP, (STP refers to Standard Pressure and Temperature - one atmosphere of pressure and 0' Celsius).	1. The concept of a mole revolves around a definition of a mole that asserts that a mole equals 6.02×10^{23} atoms or molecules, 6.02×10^{23} atoms or molecules has mass equal to its atomic weight or molecular weight expressed in grams and 6.02×10^{23} atoms or molecules of a gas will occupy 22.4 liters of volume at 1.00 atmospheres of pressure and 0' Celsius. (Standard Pressure and Temperature - abbreviated as STP) (6.02×10^{23} is also known as Avogadro' Number).
2. Students must be able to calculate the molar mass of a molecule using a Periodic Table as a reference.	2. Molar mass consists of the sum of the atomic weights of all atoms expressed in grams. The molar mass of a compound contains 6.02×10^{23} molecules.

3. Calculation of the amount of product produced in a chemical reaction from a specified amount of a reactant or calculating the number of reactants required to produce a specified amount of a product. 4. When given equal or differing amounts of two different reactants in a balanced chemical equation, students must be able to determine which of these reactants will limit the number of products to the smallest amount when completely reacted. This is known as the limiting reactant. Additionally, students must be able to calculate the leftover amount of the non-limiting reactant. This reactant is known as the in excess reactant.	3. Students must recognize and understand that the coefficients in balanced chemical equations represent the ratio of moles of the reactants and products. These proportional coefficients are used in calculations, known as stoichiometry, of reactants needed or products produced during the chemical reaction. There are four <u>basic</u> dimensional analysis/factor label calculations using the coefficients of a balanced reaction. a. given number of moles to calculate an unknown number of moles. b. given number of moles to calculate an unknown number of grams. c. given number of grams to calculate an unknown number of moles. d. given number of grams to calculate an unknown number of grams. 4. Students must understand and be able to apply the correct stoichiometric calculations to determine the limiting and in excess reactants and calculate the remaining amount of the in excess reactant. The limiting reactant will produce the smallest amount of products. When the limiting reactant is completely consumed, the reaction will stop, leaving an amount of the in excess reactant left over. The amount of the in excess reactant left over can be calculated with a stoichiometric calculation using the amount limiting reactant as a given and the amount of in excess reactant as the unknown. The amount of in excess calculated, is the amount that is consumed during the reaction, this is then subtracted from the initial amount when the reaction started to determine how much is left

	over.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why is the mole an important measurement in chemistry? Is it based only on Avogadro's number?	1. The concept of the mole applies not only to particles of matter (atoms and molecules, but also applies to the mass of atoms and molecules. The mole concept also applies to volumes of a gaseous matter at specified conditions of pressure and temperature (STP).
2. What is the relationship between a mole of a substance and its mass?	2. The molar mass of an element or a compound is the mass of 6.02×10^{23} atoms of an element or molecules of a compound.
3. How is the mole concept related to a balanced equation?	3. The coefficients next to each reactant and product of a balanced chemical equation represent the ratio of moles of all the reactants and products in the balanced equation.
4. How is the mole concept used in calculations involving balanced chemical reactions?	4. Calculations related to balanced chemical equations employ the ratio of the coefficients of the reactants and products. These ratios are the mole ratio of all the reactants and products of the chemical reaction. Using these ratios, calculations of products formed or reactants required in a chemical reaction can be performed. These types of calculations are referred to as stoichiometry. The calculations can involve masses, moles, or volumes of a gas. All these calculations are based on the mole ratio of the balanced equation.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Informational Texts and/or Media: • *Chemistry: Principles and Reactions* by Hurley and Masterson • *Modern Chemistry* by Raymond E. Davis • *Problem Solving for Chemistry* Edward I. Peters **Online Resources / Websites:** • **Stoichiometry Direct Instruction Notes:**   ○ https://www.franklinboe.org/cms/lib/NJ01000817/Centricity/Domain/2395/Stoichiometry%20PPT.pptx

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Avogadro's Number** = the number of atoms or molecules in one mole = 6.02 X $10^{23.}$
2. **mole** - a unit of measurement for particles such as atoms or molecules (see Avogadro's number).
3. **molar mass** - the mass of the atomic weight of an element or molecular weight of a molecule expressed in grams.
4. **STP** - standard pressure and temperature. An internationally agreed set of measurements related gasses (1 atmosphere pressure and 0' Celsius).
5. **22.4 liters** - The volume of one mole of a gas measured at STP.
6. **Stoichiometry** - the proportional relationship between quantities of reactants and products in a balanced chemical reaction, typically a ratio of whole numbers. This ratio allows calculations of quantities of reactants needed and products produced in a chemical reaction.
7. **limiting reactant** - the reactant that is consumed first in a chemical reaction and therefore limits how much product can be formed.
8. **excess reactant** - the quantity of a reactant that remains after the limiting reactant has been completely consumed in a chemical reaction.
9. **percentage yield** - percent yield = the actual yield divided by the theoretical yield multiplied by 100 (to convert to a percentage). The theoretical yield is the maximum amount of product a chemical reaction could produce.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: This week will begin with a two-part lab. In the first part, students estimate the length of a molecule of stearic acid. In the second part, students will experimentally estimate Avogadro's number using stearic acid, and in a separate procedure, using aluminum foil. This lab will consume approximately 2 class periods. Students will be given class time to perform calculations in both parts of the lab with the teacher circulating around class to answer questions and assist students who may be having difficulty with the calculations. In the next class, the review of lab results and discussion will lead into an introduction of the concept of a mole as 6.02×10^{23} atoms or molecules, , molar mass and molar volume of a gas at STP. Students will be given an assignment of practice problems calculating molar masses, calculating moles given mass, calculating moles given several atoms or molecules, calculating moles given a volume of gas at STP. Students will also be informed that a formative quiz will be given after the homework is reviewed in the following week
Week 2: A review of the mole assignment will take place and student questions about the assignment will be addressed. Following this review, a formative quiz on calculating molar mass, and moles will be given. As time allows, the quiz will be graded during class, grades recorded and returned to students to review. After questions about the quiz are addressed, a PowerPoint will be used to introduce stoichiometry. Students will be given notes outline to accompany the PowerPoint. The class will conclude with the distribution of an assignment including problems using all of four basic patterns of stoichiometric calculations. Students will be told a formative quiz on the four basic types of stoichiometric problems will be given after a review of the stoichiometry assignment. The quizzes will be graded and returned to students for review in the next class period. Students will be assigned to read through an experiment procedure for a lab to be performed in the following week.
Week 3: Following this review, a demonstration of the safe use of Bunsen burners will be done and students will, using safe procedure, use burners to bend pieces of glass tubing for students to practice safe burner use. In the next class, students, working in pairs, will perform a lab to determine the formula of a hydrated chemical. This experiment involves the use of Bunsen burners to heat a hydrated salt and gather data about mass changes in the sample of the salt because the water molecules have been driven off the salt leaving anhydrous molecules of the salt. Using the ratio of the moles of driven off water to the moles of anhydrate that remains, students will be able to calculate the formula of the hydrated salt. Students will be assigned to complete all calculations and questions for the lab to be reviewed in the next class. The next class will be used to discuss and review lab results and to have the students work on practice problems using data like the lab just completed to calculate the formula of a hydrate.
Week 4: Returning to the stoichiometry PowerPoint and the previously distributed notes outline, the concept of limiting reactants will be discussed. Sample limiting reactant demonstration problems are included on the notes outline. The process to solve them will be demonstrated for the class followed by 3 practice problems for the students to solve. The practice problems will be reviewed by asking students to use the whiteboard to show how they solved them. (The chosen students will have correctly solved the problems). Following a question answer session, an assignment of limiting reactant problems will be given. In the next class, the

homework problems will be reviewed once again calling on students to the whiteboard to show their calculations. The students will be instructed to prepare for a formative quiz on limiting reactants to be given at the start of the next class. In the next class, when all students have completed the formative quiz, the problems will be reviewed for the class.
Week 5: This week will focus on calculating the amount of excess reactant left over when a reaction stopped. More practice problems about this calculation will be done and reviewed in class. Following this, the notes outline, and PowerPoint will be completed covering the topic of percentage yield of a reaction and how to calculate it followed by several practice problems for students. As the end of the week approaches, a Unit 3 summative assessment on moles, and all topics studied in stoichiometry will be announced for the following week. A comprehensive review packet will be distributed along with a test outline. In addition, a reference sheet will also be distributed for students to use in preparing for the assessment.
Week 6: The Unit 3 summative assessment will be given in the first class of the week.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

- Students will be applying math skills (critical thinking) in problem solving and use communication skills taught in other subject areas, such as ELA.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content and more rigorous testing in their summative assessments. For example, Students in Honors Chemistry will be expected to use a more limited reference sheet for use on their unit assessment compared to College Prep Chemistry. Honors will explore at a higher-level limiting reactant problem.

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Mole and Molar Mass Formative Quiz

50 Points

1 mole = 6.022×10^{23} atoms or molecules = atomic or molecular weight expressed in grams (reference information)

1. How many moles of KNO_3 are contained in 404.4 grams of this chemical?

2. How many moles of H_2O are contained in 7.65×10^{24} molecules of water?

3. How many grams of $CaSO_4$ are contained in 98.0 moles of this chemical?

4. Calculate the number of grams that are contained in 3.96×10^{22} molecules of O_2?

5. Calculate the molar mass of the following compounds:

a. BaOH

b. $MgSO_4$-7 H_2O

c. $Ca(NO_{3-})_2$

d. $C_6H_{12}O_6$

e. $(NH_4)_2SO_4$

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Moles and Stoichiometry

140 Total Points

1.How many moles of KNO_3 are contained in 404.4 grams of this chemical.

2. How many moles of H_2O are contained in 7.65×10^{24} molecules of water?

3. How many grams of $CaSO_4$ are contained in 98.0 moles of this chemical?

4. Calculate the number of grams that are contained in 3.96×10^{22} molecules of O_2?

5. Calculate the number of NH_3 molecules contained in 180 grams of the NH_3 .

6. How many grams of Na_2SO_4 are contained in 7.76 moles of $NaSO_4$?

7. How many moles of N-$_{2-}$ gas are contained in 128 liters of this gas at STP?

8. How many liters in volume will 5.29×10^{27} atoms of Helium gas occupy if the gas is at STP?

The balanced equation below applies to problems 9, 10, 11, and 12

$$C_8H\text{-}_{18} \quad + \quad 25\ O_2 \quad \rightarrow \quad 16\ CO_2 + \quad 18\ H_2O$$

9. How many moles of H_2O will be produced when 9.00 moles of C_8H_{18} are completely burned in this reaction.

10. How many grams of O_2 are needed to produce 28.0 moles CO_2?

11. If 290 grams of C_8H_{18} are completely burned in the reaction above, how many grams of O_2 will be needed in this reaction?

12. If 548 grams of O_2 are consumed in this reaction, how many moles of CO_2 will be produced?

13. Huge quantities of SO_2 are produced from ZnS in the reaction below.

$$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$$

If the typical yield is 86.78%, how much SO_2 should be expected if 4897g of ZnS are used?

14. Cl_2O is sometimes used as a powerful chlorinating agent in research. It can be produced by reacting Cl_2 with heated HgO according to the following balanced equation:

$$HgO + Cl_2 \rightarrow HgCl_2 + Cl_2O$$

What is the percent yield, if the quantity of the reactants is sufficient to produce 0.86g of Cl_2O but only 0.71 g is obtained?

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 4: Chemical Nomenclature
Pacing	2 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:

Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction,

reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of

technology’s capacity to link to other information and to display information flexibly and dynamically.

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection.

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-2.

Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to determine what type of compound they are naming.	1. Most ionic compounds are composed of a positive metal ion and a negative nonmetal ion. Ionic compounds may also contain polyatomic ions in their formula. Molecular compounds are composed of nonmetals and are covalently bonded molecules. Hydrocarbons are composed of Carbon atoms.
2. Given a chemical formula, students must be able to name the compound.	2. The key to naming chemical formulas is being able to recognize the category of the chemical formula, use the appropriate prefixes or endings of the names of the chemical, and other information such as a Roman Numeral. They must also know and be able to apply a set of “rules” for naming each category of formulas.

3. Given the name of a chemical, students must be able to write the formula of that chemical.	3. The name of a chemical substance includes information to write the correct formula. This information includes whether metals and nonmetals are in the name, only nonmetals are in the name, Roman Numerals are in the name, and the prefixes and endings in the name.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How are chemicals named?	1. Students must understand how to recognize what type of chemical they are trying to name. The types of chemicals include ionic, molecular, hydrocarbon, oxyanions and acids or bases. After recognizing the type of chemical, there are different sets of rules to follow to name them, Ionic compounds containing metals that may, for multiple cations, require knowing how to use Roman Numerals or different endings in the name.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters (a resource text for practice and formative assessments)

Online Resources / Websites:

- https://www.youtube.com/watch?v=CVkqbHK7VhQ
  - Naming Compounds part 1 Bozeman Science
- https://www.youtube.com/watch?v=mrhE4lyqJ0A
  - Naming Compounds part 2 Bozeman Science

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. ion - an atom or group of atoms bonded together that have a positive or negative electrical charge.

2. cation - a positively charged ion.

3. anion - a negatively charged ion.

4. polyatomic ion - an ion composed of (two (or more) atoms that are bonded together.

5. molecular compound - a compound composed of two nonmetals. It is also known as a covalent compound.
6. hydrocarbon - a molecule composed of carbon and hydrogen and occasionally oxygen atoms.
7. alkanes - hydrocarbons where all atoms are bonded with single bonds.
8. alkenes - hydrocarbons where there is at least one double bond between two carbons.
9. oxyanions = negative polyatomic ions that contain one (or more) oxygen atoms.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: Week one begins with the class viewing two videos on naming chemicals. The videos cover the basic rules for naming chemicals. Following the videos, students will receive a handout with more detailed information regarding naming chemicals, organized into sections about naming the different types of chemicals. Each section is explained by the teacher and students will work on practice naming problems. in each class. A short formative assessment will be given at the beginning of each class covering the previous class period's work. It is anticipated that the class will cover two or three types of chemicals in each type of chemical naming.

Week 2: The same pattern of instruction will continue in the second week. It is anticipated that a comprehensive review of nomenclature will take place at the end of this week for a summative assessment scheduled for the first-class period on week three.

Week 3: A one period summative assessment will take place in the first-class period of this week.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

- ☒ Critically Problem Solving
- ☒ Effectively Communicating
- ☒ Creatively Thinking
- ☒ Persevering
- ☐ Socially Aware
- ☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry versus Honors Chemistry.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, students in Honors Chemistry will be responsible for being able to name a series of oxyanions where the anions either loss or gain oxygen atoms. This gain or loss of oxygen can impact the prefix and ending of the names. In addition, students in Honors Chemistry will also be studying naming series of hydrocarbon compounds.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable: **Ionic and Covalent Compounds Quiz**

1) TeO_3

2) CS_2

3) $Fe(OH)_3$

4) CaO

5) P_4Se_3

<u>Write the formula of each ionic or covalent compounds named below</u>

6) bromine pentachloride

7) tetraphosphorus trisulfide

8) lithium acetate

9) zinc (II) phosphide

10)barium nitride

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Nomenclature Unit Test

1. Determine the chemical formula for the following compounds:

a. chromous oxide

b. barium nitrate

c. potassium oxalate

d. sodium chromate

e. phosphoric acid

f. silicon monoxide

g. ammonium acetate

h. dinitrogen pentoxide

i. aluminum carbonate

j. calcium hydroxide

2. Determine the type of compound (ionic, molecular, or acid) and the chemical name:

	Type	Chemical Name
a. $Mn(OH)_4$		
b. Na_2SO_4		
c. $FeCl_2$		
d. HNO_2		
e. S_2O_4		
f. $Ca_3(PO4)_2$		
g. CuS		
h. HCl		

i. CBr_4

j. CO_2

Multiple Choice:

_____ 1. The prefix hydro is used to:
a.indicate there is no oxygen in an acid
b. indicate an acid has hydrogen
c. identify a formula as a provider of hydroelectric power

_____ 2. Which of the following formulas is correct?
a. NaO
b. CaBr
c. $K_2Cr_2O_7$
d. $CaCN_2$

_____ 3. Which of the following is the incorrect chemical formula for the compound named?
a.acetic acid $HC_2H_3O_2$
b.calcium sulfate $CaSO_4$
c.magnesium hydroxide $Mn(OH)_2$
d. sulfurous acid H_2SO_3

4. Write the word true or false on the line:
_______________ a. Nonmetals and nonmetals combine to form ionic compounds.

_______________ b. In a molecular formula, mono- is never used on the second element in the formula.

.

_________________c All ions formed by Group 2 elements have a charge of -2.

________________ d. Groups 15, 16, and 17 anions will always end in -ide.

________________ e. All ions formed by Group 17 elements have a -1 electrical charge

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 5: The Kinetic Molecular Theory and The Behavior of Gasses
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the tex

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS-1-3: Plan and investigate to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS-1-9: Analyze data to support the claim that the combined gas law describes the relationships among volume, pressure, and temperature for a sample of an ideal gas.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Speaking and Listening: Students will be able to present solutions of problems to a class in an organized and accurate manner. Their presentations must hold the attention of the class and the presenter should also be able to answer questions from the class.

Math: Students will be able to perform calculations employing algebra, scientific notation and the dimensional analysis method in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to describe, on an atomic or molecular level, what is meant by the Kinetic Molecular Theory.	1. The concept that atoms and molecules are in constant motion and that the average kinetic energy associated with the motion of the atoms or molecules is directly related to the temperature of these particles.
2. Students must be able to convert the Celsius temperature scale to the Kelvin temperature scale and be able to describe why it is necessary to use the Kelvin temperature scale in performing gas law calculations.	2. Adding 273 to the celsius temperature will convert it to the Kelvin scale. The reason for using the Kelvin scale in gas law calculations is that the Kelvin scale does not have negative temperatures. It has been determined that at -273 ‘C, atomic and molecular motion would stop. Negative temperatures in gas law calculations could lead to undefined values such as a “negative volume”.
3. Student must be able to describe the type of proportion	3. The pressure and volume of a gas are inversely

(direct or inverse) that exists between the properties of gasses including temperature, volume, pressure, and the amount (measured in moles)	proportional if temperature and amount remain constant. (Boyle's Law). The volume and temperature of a gas are directly proportional if the pressure and amount remain constant. (Charles' Law) The pressure of a gas is directly proportional to the temperature if the amount and volume remain constant. (Gay-Lussac's Law) The pressure and amount of a gas are directly proportional if the volume and temperature remain constant. (Ideal gas Law)
4. Students must be able to apply the appropriate gas law in solving problems involving the properties of a gas including pressure, temperature, volume, and amount.	4. Boyle's Law applies to problems involving pressure and volume. Charles Law applies to problems involving volume and temperature. Gay-Lussac's Law applies to problems involving pressure and temperature in a sealed container. The Combined Gas law applies to problems involving pressure, temperature, and volume. The Ideal Gas Law applies to problems involving pressure, temperature, volume, and the amount of gas.
5. Students must be able to calculate the pressure generated by each gas in a mixture of gasses, given the mass of each gas in the mixture and the total pressure,	5. Students must know how to convert mass of elements or compounds into moles. They must also know that the percent of moles of each gas in the total number of moles in the mixture is the same percent of the total pressure the mixture of gasses are generating.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How is the Kinetic Molecular Theory related to the properties of ideal and real gasses?	1. The Kinetic Molecular Theory states that molecules or atoms are in constant motion. Gas molecules are constantly elastically colliding with each other and the walls of a container. These collisions are elastic because

	there is no net loss of energy from the collisions. Gas particles are separated by large distances. The size of gas particles is tiny compared to the distances that separate them and the volume of the container. There are no interactive forces, such as attraction or repulsion, between the molecules or atoms of a gas. The average kinetic energy (energy of motion) of gas molecules or atoms is dependent on the temperature of the gas.
2. How does a change of phase in matter (ex. solid to liquid or liquid to solid. liquid to gas etc.) relate to the Kinetic Molecular Theory?	2. As the temperature of the molecules or atoms (particles) changes, the average kinetic energy (energy of motion) of these particles also changes. An increase in temperature will increase the average kinetic energy of particles. If the temperature increases enough, it results in the particles of a solid to move with sufficient energy to overcome the forces that hold the particles in place in the solid and become a liquid, where the particles can move freely, but remain in contact with other particles as they move. If the temperature continues to increase sufficiently, the particles could escape any forces of attraction between the particles in the liquid phase. The particles would then become gasses, where the particles are separated completely and moving with increased average kinetic energy and elastically colliding with each other and the walls of the container as they move. The opposite sequence of change in phase would occur, such as a gas condensing to a liquid or a liquid freezing to a solid, if the temperature is decreased. This causes the average kinetic energy of the particles to decrease. This decrease in average kinetic energy of the particles is not sufficient to continue overcoming the attractive forces between the particles.

3. What information does a phase diagram or graph provide for a change in the state of a substance?	3. A phase diagram or graph provides information such as the melting temperature of a solid or the freezing temperature of a liquid. It also shows the temperature changes that occur in the melting and freezing processes/
4. How do pressure, temperature and the volume of gasses mathematically relate with each other?	4. The relationship of the pairs of these factors can be explained in three basic gas laws. Boyle's Law states that pressure and volume of a gas are inversely proportional if the temperature of the gas remains constant. Charles Law states that the volume of a gas is directly proportional to temperature if the pressure remains constant. Gay-Lussac's Law states that the pressure of a gas is directly proportional to the temperature if the volume of the gas remains constant. These proportional relationships can be combined into one mathematical expression known as the Combined Gas Law.
5. Is there a gas law that incorporates the amount of gas, measured in moles, with pressure, temperature, and volume?	5. The Ideal Gas Law is a mathematical expression that incorporates pressure, temperature, volume, and amount of gas and allows calculation of one of these four factors if the other three factors are known. There is a constant, identified as *R* (the ideal gas constant), that is also incorporated into this law. There are multiple values for *R* dependent on the units used to measure volume and pressure. The temperature for all gas laws is measured in the Kelvin scale and amount is always in moles.
6. How is the Kelvin scale temperature determined and why is it used in the gas law calculations?	6. The Kelvin temperature is calculated by adding 273 to the Celsius temperature. The Kelvin scale does not have any negative numbers. The gas laws are based on the Kinetic Molecular Theory. It has been determined that

	all atomic or molecular motion would cease at -273' Celsius. The use of negative temperatures in gas law calculations can produce mathematically undefined results such as negative volumes. The use of the Kelvin scale eliminates this issue. In the Kelvin scale, 0' Kelvin, which equals -273' Celsius, is referred to as "Absolute Zero" where all atomic and molecular motion stops.
7. How is the pressure generated by each gas in a mixture of different gasses in a closed container determined?	7. The partial pressure of each of the gasses in a closed container is in the same proportion as the percent of total moles of each gas in the mixture of gasses.

Resources
Student Technology Integration and [Correspondence to ISTE Standards]: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters (a resource text for practice and formative assessments)

Online Resources / Websites:

- https://orise.orau.gov/index.html
  - Source of Gas Laws/Kinetic Molecular Theory Activities

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Amorphous solid -** a non-crystalline solid that does not organize the atoms and molecules in a definite networked pattern.

2. **Boiling point -** The temperature of a liquid where the atoms or molecules possess sufficient kinetic energy to overcome the forces of attraction between the particles in the liquid phase and become a gas.

3. **Condensation -** Condensation is the process through which the physical state of matter changes from the gaseous phase into the liquid phase.

4. **Dalton's law of partial pressures -** Dalton' law of Partial Pressure states that the total pressure of a mixture of gasses is equal to the sum of the partial pressures of the component gasses: It further states that the percent of the total pressure of each gas is the same aa the percent of the total moles of each gas**.**

5. **Freezing point -** The temperature where the kinetic energy of atoms or molecules of a liquid is not sufficient to maintain a liquid state and the liquid becomes a solid.

6. **Kinetic Molecular Theory -** The Kinetic Molecular theory states that atoms or molecules are in a constant state of motion. The kinetic energy of the moving atoms or molecules is related to the temperature of the atoms and molecules.

7. **Kinetic Energy -** the energy of an object in motion.

8. **Elastic Collision -** a collision in which there is no net loss in kinetic energy because of the collision. Both momentum and kinetic energy are conserved quantities in elastic collisions. Atoms and molecules of a gas engage in elastic collisions as they collide.

9. **Kinetic Energy calculation. -** Kinetic energy is calculated using the equation K. E. = ½ (mass) (velocity^2). This equation indicates that velocity contributes the most to kinetic energy.

10. **Melting point -** The temperature at which the kinetic energy of atoms or molecules in solids are sufficient to overcome the forces of attraction of the particles composing a solid to change into the liquid phase.

11. **Phase diagram** - a graphic representation of the temperature changes during the change of state of a substance.

12. **Pressure -** force per unit area.

13. **Sublimation -** a change of state of a solid directly to a gas, for example dry ice.

14. **Avogadro's Principle -** Avogadro's Principle states that equal volumes of a gas at the same temperature and pressure contain the same number of atoms or molecules.

15. **Boyle's Law -** Boyle's Law states that the volume of a gas is inversely proportional to the pressure.

16. **Charles' Law -** Charles' Law states that the volume of a gas is directly proportional to the temperature.

17. **Gay- Lussac's Law -** Gay-Lussac's Law states that the pressure of a gas in a sealed container is directly proportional to the temperature.

18. **The Combined Gas Law - the** Combined Gas Law incorporates the pressure, volume and temperature into one equation arranged so as to maintain the proportions as noted in Boyle's, Charles' and Gay Lussac's Laws.

19. **Ideal Gas Law -** The Ideal Gas Law, in addition to pressure, volume and temperature includes the amount of gas measured

in moles. This law includes a constant, identified as *R.* There are multiple values for *R,* dependent on which units are used for volume and pressure.

20. **Ideal Gas Constant -** a constant used in the Ideal Gas Law. It is calculated: *R* = (pressure) (volume) / (moles)(‘K). Moles are represented by the letter *n* and the units for volume could be either liters or milliliters. The units for pressure could be atmospheres, mmHg or kilopascals.

21. **Molar Volume at STP -** one mole of a gas at Standard Pressure (1 atmosphere) and Standard temperature (0’C or 273 ‘K) will occupy 22.4 liters.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Learning Tasks Per Week (Including Instructional Strategies)
Week 1: This week will start with a demonstration of a simple phenomenon where a balloon is attached to the opening of an Erlenmeyer flask. The flask is then gently heated on a hot plate. As the flask becomes warmer, the balloon will begin to inflate and increase in volume. The flask is then immersed in an ice water bath and the volume of the balloon decreases, possibly to a point where the volume of the balloon is less than when the balloon is at room temperature. This phenomenon leads to a discussion about the basic concept of the Kinetic Molecular Theory and how it relates to gasses. A second demonstration lab will also take place where data is collected by students about the gas pressure in a sealed container at three different temperatures. The data includes the gas pressure at room temperature, at 100’ C, and a temperature below 0’ C. The pressure is related to the kinetic energy of molecules in the sealed container. Students then graph the data and estimate the temperature at which the pressure drops to zero indicating the temperature at which atomic or molecular motion would stop. (-273’C) A discussion of the Kelvin temperature scale and why it is used in gas laws take place. As time allows in the week, students will perform an experiment to determine the melting and freezing temperatures of an unknown solid. In this experiment, a phase diagram (graph) is drawn from the melting/freezing data collected. The phase diagram is used to identify the solid based on the melting/freezing temperature determined from the phase diagram.
Week 2: If needed, time will be taken to complete the melting/freezing temperature experiment. After the melting freezing temperature lab is completed and discussed, students will perform an experiment where the goal is to derive Boyle’s Law. After completion and discussion of this experiment, a quick activity about Charles law will be done by students. The three basic gas laws,

Boyles, Charles and Gay-Lussac's will then be summarized. The proportions of pressure, temperature and volume will be emphasized as each law is discussed. Practice problems will be done for Boyles, Charles and Gay Lussac's laws in class. A formative quiz covering these three laws will be given at the beginning of the next class period. Following the formative quiz, the combined gas law will be discussed and practice problems about it will be done in class. The last class of the week will focus on how the Ideal Gas Law and how the Ideal Gas Constant is derived for different pressure and volume units. Demonstration problems will be solved for students and work on practice problems will be assigned as homework. In the following class period, the assigned problems will be reviewed. Students will be asked to solve the problems on the whiteboard for the class, after it has been determined that the students had correct solutions.
Week 3: During this week, Dalton's Law of Partial Pressure will be introduced. Practice problems applying this law will take place in class and a short formative quiz on the Ideal Gas Law, Dalton's Law of Partial Pressure will be announced for the first-class period of the next week.
Week 4: Following the students' completion of the formative quiz, the problems on the quiz will be discussed and solved on the whiteboard. A discussion with students will then take place about what to include on a reference sheet for use on a summative assessment to take place in week 5. After this discussion, a "practice test" will be distributed to the class as a review assignment for a summative test on this unit. The last class of the week will be reviewing the problems on the practice test and a question/answer session will also take place.
Weeks 5 and 6: The summative unit test will take place in the first-class period of this week. The problems on the test will be reviewed in the second-class period of the week. The tests will be returned in the third-class period of the week and a question answer session about the test will take place.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, more limited reference sheets on assessments and more difficult problems on their assessments

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Ideal Gas Law and Dalton's Law of Partial Pressure Formative Quiz

1. Three gasses are mixed in a sealed container. Gas 1 generates a pressure of 750 mmHg; Gas 2 generates a pressure of 75 mmHg and gas three generates 73.2 mmHg of pressure. What is the total pressure of the gasses in the container?

2. A steel tank has a mixture of Helium and Oxygen gasses. The total pressure in the tank is 6075 mmHg at a constant temperature. If the oxygen generates a partial pressure of 1865 mmHg, what is the pressure generated by the Helium?

3. A balloon is at a constant temperature of 32'C and volume is inflated with a mixture of 92.0 grams He, 85.0 grams of N_2, and 100 grams of F_2 gasses. The total pressure in the balloon is 800 mmHg. What is the partial pressure of each of the gasses in the balloon?

4. Calculate the volume, in liters, of 12.0 moles of oxygen at a pressure of 2.50 atmospheres and a temperature of 40.0 'C

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Kinetic Molecular Theory and Gas Laws

Directions: You may use a periodic table and your reference sheet. You must show your work and label answers with correct units to receive full credit for a problem.

1. How does the Kinetic Molecular Theory explain gasses generating pressure in a container? Also, why would the amount of pressure vary under different conditions? 10 points

2. Explain why, according to the Kinetic Molecular Theory, in Boyle's Law, pressure and volume are inversely proportional. 10 points

3. Calculate the temperature, in degrees Celsius, required to maintain the pressure in a steel tank of oxygen at 7000 mmHg. The volume of the steel tank is constant, and no oxygen is added or released from the tank. 10 points

4. A weather balloon has a volume of 150 liters, a pressure of 1.10 atmospheres and a temperature of 29.0 degrees Celsius on the ground before launching. At its maximum altitude after launching, calculate the volume of the balloon if the temperature is -20.5 degrees Celsius and the pressure is .450 atmospheres. 10 points

5. A piston in a cylinder is holding a volume of gas at 2.56 liters in the cylinder with a pressure of 1140 mmHg. What will the

pressure become if the piston is pushed in to lower the volume to 1.30 liters?
10 points

6. Another unit used to measure air pressure by meteorologists is the “bar”. One bar = 750.062 mmHg.
Calculate a value of *R* for the Ideal Gas Law using bars as the pressure unit, assuming volume is measured in milliliters, temperature is 273 degrees Kelvin and there is one mole of gas involved. 10 points

7. A child’s balloon has a volume of 15.0 liters at STP. calculate the volume of the balloon if the temperature of the balloon is raised to 29.0 degrees Celsius and the pressure rises to 1.50 atmospheres? 10 points

8. A metal tank is filled with 200 grams of Helium, 150 grams of Oxygen and 40.0 grams of nitrogen. (Oxygen and nitrogen are diatomic elements). If the total pressure in the tank is 3260 mmHg. Calculate the partial pressure of each gas in the tank.
10 points

9. An inflated life jacket has a volume of 27.5 liters at a temperature of 32.8 degrees Celsius. What would the volume of the life jacket become in water at 19.6 degrees Celsius? 10 points

10. Calculate the number moles of helium gas contained in a weather balloon inflated to a volume of 79.0 liters, a pressure of 750 mmHg and is at a temperature of 37 degrees Celsius.
    10 points

Bonus: 5 points

Calculate the kinetic energy of a motorcycle with a mass of 175,000 grams traveling at a speed of 110 km per hour.

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 6: Solutions
Pacing	6 Weeks

CT State Standards

What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the tex

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-3. Plan and investigate to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information
stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to identify solute and solvent in a solution.	1. Students must know that a solute is a substance being dissolved to make a solution and solvent is the substance dissolving the solute.
2. Students must be able to predict precipitates that will form in a reaction of ionic solutions using the solubility rules.	2. Students must know how to apply solubility rules to predict precipitates in a reaction between two ionic sl\olutions.
3. Students must be able to calculate the molarity of a solution given the grams and formula of a solute and the final volume (in liters) of the solution.	3. Students must know how to convert grams of a solute to to moles and know that molarity is calculated by dividing moles of solute by liters of solution.
4. Students must be able to calculate the molality of a solution given the number of grams of solute and the mass of the solute in kilograms.	4. Students must know how to convert grams of solute to moles and that water has a density of 1.00 gram per milliliter. They must also know how to convert milliliters to kilograms.

5. Students must be able to determine changes in colligative properties of solutions given the formula of the solute, the grams of solute in the solution and the kilograms of solvent. 6. Students must be able to calculate the molecular weight of an unknown solute using the equation for calculating changes in freezing or boiling temperature of a solution. 7. Students must be able to determine the mole fraction of a solute in a solution. 8. Students must be able to determine the percent concentration of a solute in a solution given the number of grams of solute and grams of the solvent (or milliliters of water) as the solvent.	5. Students must know how to convert grams to moles, calculate the molality of a solution and how to calculate changes in the colligative property using the appropriate constant for that particular property. 6. Students must know how to mathematically manipulate the equation to determine the change in the boiling or freezing temperature of a solution to solve for the molecular weight of the solute. 7. The student must know how to apply the equation to calculate the mole fraction of a solute in a solution. 8. Students must know how to apply the equation for calculating the percent concentration of a solute in a solution. Students must also know that one milliliter of water has a mass of 1.00 grams.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What are the components of a solution? 2. What are the characteristics of a solution? 3. What are four quantitative ways to describe the concentration of solutions?	1. A solution is composed of a solvent and a solute. The solvent dissolves the solute. 2. A solution is a homogenous mix of a solvent that has dissolved a solute. 3. Four quantitative ways to describe the concentration of a solution include: molarity (moles of solute per liter of

	solution), molality (the number of moles of solute per kilogram of solvent), mole fraction (the number of moles of solute divided by the total of moles of solute plus moles of solvent), and mass percent of solute (the grams of solute divided by grams of solution, multiplied by 100).
4. What are colligative properties?	4. The physical changes in a solution that result from adding solute to a solvent. The four types of colligative properties include: boiling temperature increases, freezing temperature decreases, vapor pressure increases and osmotic pressure of a solution, preventing solute from easily passing through a semipermeable membrane. Calculation of these types of changes is associated with the molality of a solution.
5. What is solubility?	5. Solubility is the number of grams of a solute that will dissolve in each amount of solvent at a specified temperature.
6. What is meant by the statement "like dissolves like"	6. "Like dissolves like" refers to solutes that are more likely to dissolve in solvents that have similar chemical properties, such as hydrocarbon solvents will be more likely to dissolve hydrocarbon solutes.

Resources

Student Technology Integration and Correspondence to ISTE Standards:

1.1 Empowered Learner
Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1.2 Digital Citizen
Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters (a resource text for practice and formative assessments)

Online Resources / Websites:

- https://www.youtube.com/watch?v=AsCLuLS-yZY (solubility rules mnemonics)

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Homogeneous mixture** - a mixture where all components of the mixture are uniformly distributed in the solution.

2. **solvent -** a chemical that dissolves other chemicals.

3. **solute -** a chemical that is dissolved in a solvent.

4. **solubility -** the amount of solute that will dissolve in a specified amount of solvent at a specified temperature.

5. **concentration -** a quantitative measurement of the amount of solute dissolved in a solvent. It measures the "strength" of the solution.

6. **molarity -** a measure of concentration described as the number of moles of solute per liter of solution.

7. **molality** = a measure of concentration described as the number of moles of solute per kilogram of solvent.

8. **mole fraction -** a measure of concentration described as the proportion of moles of solute in a solution to the total of moles of solvent plus solute.

9. **percent concentration -** a measure of concentration described as the grams of solute divided by grams of solvent and then multiplied by 100.

10. **colligative properties -** Physical properties of a solution that are impacted by the amount of solute dissolved in the solvent. These properties include a rise in boiling temperature, a drop in freezing temperature, a decrease in vapor pressure and a change in osmotic pressure (temperature also impacts osmotic pressure).

11. **Kb -** The boiling point constant to relate molality with changes in boiling temperature of a solution. The value of the constant for water as a solvent is .512 'C/molal concentration. There are different Kb values for solvents other than water.

12. **Kf -** The freezing point constant to relate molality to changes in freezing temperature of a solution. The value of this constant for water as a solvent is -1.86 'C/molal concentration. There are different Kf values for solvents other than water.

13. **precipitate -** A solid that forms because of a chemical reaction, when two solutions are mixed together. The solid that is formed is an insoluble compound in the solvent of the original solutions.

14. **net ionic equation -** A chemical equation that only shows the ions that react to form a precipitate as the reactants, and the formula of the insoluble product when two ionic solutions.

15. **spectator ions -** The ions that remain in solution (unreacted) after other ions have reacted to form a precipitate.

16. **immiscible -** Two substances that are unable to mix together, for example oil and water.

17. **saturated solution -** A solution that is unable to dissolve any more solute.

18. **supersaturated solution** - A supersaturated solution contains more dissolved solute than required for preparing a saturated solution. It can be prepared by heating a saturated solution, adding more solute, and then cooling it quickly, for example in an ice bath.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: The unit will begin with a discussion/lecture including definition of a solution, solubility, and precipitates. Following this, a video of the rules of solubility of solutes will be shown. The video summarizes a mnemonic to make it easier to remember the rules for solubility. The students will then begin an experiment where they must predict possible precipitates that will form when all possible combinations of six ionic solutions are mixed. The data collected will determine whether a precipitate form in the combinations of solutions and make observations to describe the precipitates will also be noted. Students will be assigned to confirm their predictions and write chemical equations of the combinations of solutions that produced precipitations and then a net ionic equation for each reaction. In the next class, the assignment will be reviewed to open the class period, and students will make any changes as needed in their reactions. Once this is completed, students will be instructed on how to calculate the molarity of a solution and be given several molarity practice problems to solve in class. As time allows, a demonstration of a supersaturated solution will be done. Students are assigned to prepare for a formative quiz on molarity in the next class. The last class of the week will consist of the formative quiz, followed by demonstration problems on how to calculate the molality of a solution. Students will be assigned molality problems due at the beginning of the next class.

Week 2: The molarity quizzes will be returned and reviewed, giving students time to ask questions and correct the problems. Following this, the molality assignment problems will be reviewed by having students show and discuss their solution to the problems on the whiteboard. A lecture discussion will then take place, employing a notes outline, on colligative properties.

Specifically, the relationship of molality and how this affects boiling and freezing temperature of water will be discussed. The notes will focus on an equation used to calculate the change in boiling and freezing temperatures of water. Boiling and freezing point constants of water are discussed as an integral part of the equation as well as the importance of the number of particles (ions or molecules) in the calculation. Sample problems of calculating freezing and boiling temperatures of water solutions will be demonstrated by the teacher and will be included in the notes outline. Students will be assigned practice problems involving molality and colligative properties due in the next class.
Week 3: Assigned problems will be reviewed in class to begin the week. Sample problems will be done as demonstrations of how to calculate the molecular weight of an unknown solute in a water solution. (Honors Chemistry only). Students will be given two practice problems to be done and reviewed in class. A formative quiz covering molality, and colligative properties will be assigned for the next class period.
Week 4: The formative quiz on molality and colligative properties will be given in the first-class period next week. After all students are finished with the quiz, the problems on the quiz will be reviewed. The remainder of the class will focus on how to calculate mole fraction and percent concentration including practice problems to be done in class. The rest of this week will focus on a comprehensive review of solutions in preparation for a unit summative assessment next week. The review will include a drafting of a reference sheet for use on a unit test, and practice problems based on a test outline. Students will work in small groups on these practice problems while the teacher circulates around to the groups to answer any questions. The unit six assessment will take place in the first class of next week.
Week 5: The Unit six summative assessment will be given on the first day of Week 5.

Westbrook Public Schools' Portrait of a Graduate **Learning Expectations**
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering

☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for average ability levels of students in College Prep Chemistry and Honors Chemistry.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, calculating the molecular weight of an unknown solute using change in freezing/boiling temperature (molality based and colligative properties)
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Molarity Assessment

1. Calculate the molarity of a solution when 6.53 moles of KBr are dissolved in water to make 2.10 liters of solution. **10 points**

2. Calculate the molarity of a solution when 18.4 grams of $KMnO_4$ are dissolved in water to make 1.90 liters of solution. **10 points**

3. How many moles of $NaNO_3$ should be dissolved in water to make 4.89 liters of solution with a molarity of 3.25 moles/liter. **10 points**

4. Determine the final volume of a solution prepared by dissolving 60.5 grams of $MgCl_2$ in water to make a final concentration of 2.75 M. **12 points**

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Unit 6 Solutions Assessment

1. What is the molarity of a solution that contains 10.0 grams of $AgNO_3$ that has been dissolved in water to make 750 milliliters of solution? **12 points**

2. You want to create a 0.25 M KCl solution. You weigh 5.00 grams of KCl . What will the final volume of the solution be? **12 points**

3. What is the molality of a solution that contains 48 grams of NaCl dissolved in 250 milliliters of water? **12 points**

4. What is the percentage by mass of the solute from problem 1? **12 points**

5. How many milliliters of hydrogen peroxide (H_2O_2) and water are needed to make a 8.5% solution by volume of hydrogen peroxide if you want to make 450 mL of solution? **12 points**

6. What is the mole fraction of the solute in the solution from problem 1? **12 points**

7. What is the mole fraction of the solvent in the solution from problem 1? **12 points**

8.What is the molality of a solution that contains 13.4 grams of $CaCl_2$ dissolved in 655 milliliters of water?
12 points

9. A. Determine the freezing temperature of a solution prepared by dissolving 100 grams of $Ca(NO_3)_2$ in 250 milliliters of water.
6 points

B. Determine the boiling temperature of the solution prepared in part A above. **6 points**

10. Determine the molecular weight of an unknown solute when 39.3 grams of the unknown are dissolved in
250 milliliters of water. **12 points**

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 7: Acids and Bases
Pacing	4 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a

problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-2
Matter and its Interactions: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4
Matter and its Interactions: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS1-5
Matter and its Interactions: Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, considering possible unanticipated effects.

HS-PS1-6
Matter and its Interactions: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium**.**

HS-PS1-7
Matter and its Interactions: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information
stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system. Students must be familiar with the basic definition, and how to calculate on a scientific calculator, logarithms.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to identify acids and bases by their chemical formulas.	1. According to the Arrhenius acid base theory, nonorganic acid formulas begin with a hydrogen and base formulas end with a hydroxide ion (OH^{-1}), for example HNO_3

	nitric acid and NaOH sodium hydroxide.
2. Predict the products of an acid base chemical reaction.	2. Acid base reactions are a specialized double displacement reaction. The products of an Arrhenius acid base reaction are salt and water. A salt is defined as a metal-nonmetal compound, for example NaCl or CaI_2.
3. Students must be able to identify a solution is acidic, basic, or neutral using the pH scale.	3. On the pH scale, a pH below 7 indicates an acidic solution and above 7 indicates a basic solution. A pH of 7 indicates a neutral solution (not acidic or basic). The pH scale goes from 0 to 14.
4. Students must be able to calculate the pH of a solution, given the concentration of an acid.	4. Students know that calculation of pH is based on logarithms, using the equation pH = - (log $[H^+]$). The [] symbols mean concentration in moles/liter. Students must be proficient in using a calculator to work with numbers in exponential expression and determine the logarithm of these numbers on a calculator.
5. Students must be able to calculate the pOH of a solution.	5. Students must know pOH scale is like the pH scale in that a pOH of 7 is indicative of a neutral solution. A basic solution has a pOH less than 7, while an acidic solution has a pOH of greater than 7. The pOH is convenient to use when finding the hydroxide ion concentration from a solution with a known pH. pOH is calculated using the equation. pOH = - (log $[OH^{-1}]$)
6. Students must be able to determine the $[H^+]$ given the $[OH^{-1}]$. and determine the $[OH^{-1}]$ given the $[H^+]$.	6. Students must know that the water constant is calculated by the equation $KH_{2O} = [H^+] \text{ X } [OH^{-1}] = 1.00 \text{ X } 10^{-14}$. In a chemically neutral solution, $[H^{+1}]$ and $[OH^{-1}]$ are both equal to 1.00×10^{-7}. By mathematically manipulating the K_{H2O} equation, the $[H^{+1}]$ or $[OH^{-1}]$ can be determined.

7. Students must be able to identify Bronsted-Lowry acids and bases and, in a Bronsted-Lowry chemical reaction, identify the conjugate base and acid formed from the reacting acid and base.	7. Students must know that in the Bronsted–Lowry definition of acids and bases, an acid is a proton (H^+) donor, and a base is a proton acceptor. When, in a Bronsted–Lowry chemical reaction, an acid donates a proton, a conjugate base is formed as a product in the reaction. Similarly, when a Bronsted–Lowry base accepts a proton, a conjugate acid is formed as a product in the reaction.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do the concentrations of hydrogen ion and hydroxide ion determine the acidity and basicity of a solution?	1. Concentrations of H^{+1} ions and OH^{-1} ions are related logarithmically to pH and pOH. pH and pOH are logarithmic scales that measure the acidity and basicity of a solution.
2. If you know the pOH of a solution, how do you determine the pH or if the pH is given, can you determine the pOH?	2. As a result of the logarithmic relationship of pH and pOH, the pH of a solution can be determined with the following equation: pH + pOH = 14
3. Can the concentration of H^{+1} or concentration of OH^{-1} be calculated in a water solution of an acid or base?	3. The $[H^{+1}]$ and $[OH^{-1}]$ in a water solution have the following math relationship: The product when multiplying the concentrations of H^{+1} and OH^{-1} equals a constant number of 1.00×10^{-14}. The equation $K_{H2O} = [H^{+1}] \times [OH^{-1}] = 1.00 \times 10^{-14}$ can be manipulated to solve for $[H^{+1}]$ or $[OH^{-1}]$ given the concentration of the other ion.

4. Are there other definitions of acids and bases beside the Arrhenius definition? 5. What are indicators?	4. Another definition of acids and bases is known as the Bronsted-Lowry Theory which states that acids are proton donors and bases are proton acceptors. A proton is H^{+1} ion. In the Lewis Acid/Base theory, a Lewis base donates a pair of electrons to a Lewis acid which accepts the electrons from the base. 5. Indicators are weak acids or bases that ionize in water solutions and change color in a solution when the pH of the solution changes. Different indicators will change colors in different ranges of pH.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological

methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters

Online Resources / Websites:

- A3Academy: Lewis Acids and Bases
- Brønsted-Lowry Conjugate Acid-Base Pairs

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Arrhenius acid -** a chemical that releases H^{+1} ions when dissolved in water.
2. **Arrhenius base -** a chemical that releases OH^{-1} ions when dissolved in water.
3. **Bronsted-Lowry acid -** a chemical that donates protons to a Bronsted-Lowry base.
4. **Bronsted-Lowry base -** a chemical that accepts donated protons from a Bronsted-Lowry acid.
5. **conjugate acid -** the product when a Bronsted-Lowry base gains a proton.
6. **conjugate base -** the product when a Bronsted-Lowry acid donates a proton.
7. **H_3O^{+1} -** a hydronium ion (same as a H^{+1}).
8. **acidic solution -** a solution where there are more H^{+1} ions than OH^{-1} ions.

9. **basic solution -** a solution where there are more OH^{-1} ions than H^{+1} ions.

10. **pH -** the negative log of the $[H^{+1}]$. A scale from1 to 14 that shows the acidity or basicity of a solution. 1 to 7 is acidic and 7 to 14 is basic. pH of 7 is neither acidic nor basic, it is neutral.

11. **pOH -** the negative log of the $[OH^{-1}]$. A scale from 1 to 7 that shows the basicity or acidity of a solution. 1 to 7 is basic and 7 to 14 is acidic. A pOH of 7 is neither acidic nor basic, it is neutral.

12. **amphoteric -** a substance that act as either an acid or a base, such as water.

13. **strong acid or base -** an acid or base that completely ionizes in a solution.

14. **weak acid or base -** an acid or base that ionizes only a small amount in a solution.

15. **titration -** a titration is an experimental procedure where a solution of known concentration is used to determine the concentration of an unknown solution.

16. **titrant -** the solution of known concentration used in a titration.

17. **analyte -** the solution of unknown concentration in a titration.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)
Week 1: The unit on acids and bases will begin with a phenomenon where the teacher exhales (through a straw) into water that contains a solution of phenol red indicator. As the teacher exhales, the solution's color changes from red to orange and eventually bright yellow. The class is asked for possible explanations of this observed change. Following discussion, the teacher writes a chemical equation on the whiteboard that shows that the carbon dioxide in the exhaled breath combines with water to form carbonic acid. It is explained that as the concentration of acid increases it causes the sequence of color changes. Following this demonstration, introductory notes on the Arrhenius Theory of acids and bases will be given. This then leads to discussion of pH as a

scale to measure the acidity and basicity of solutions. After a quick review of logarithms, students are instructed in the use of calculators to determine pH using the equation pH = -(log $[H^{+1}]$). Practice problems are assigned to work on in class and reviewed. Students are assigned to prepare for a formative assessment in the next class. Following the formative assessment on the Arrhenius Acid Base Theory and pH, the concept of pOH is introduced, compared to pH, and calculations of pOH are demonstrated by the teacher and practice problems are done in class and reviewed.
Week 2: The concept of the water constant, K_{H2O}, is explained and how it is used to calculate concentrations of $[H^{+1}]$ or $[OH^{-1}]$ in a water solution. Several practice problems will be demonstrated on the whiteboard and how the resulting answers can be used to calculate pH or pOH. Students will be assigned similar problems for homework due in the next class. Students will begin this assignment in class with the teacher circulating to answer questions, assist with use of calculators, and check answers as students' complete problems. The assigned problems will be reviewed in the next class by having students show their solutions to problems on the whiteboard. Following the review of the homework problems, a two problem "open note" formative quiz will take place. As time allows in class, the Bronsted-Lowry theory of acids and bases will be introduced. The introduction of this will include definitions of Bronsted-Lowry acids and bases and how to recognize them in a chemical reaction, A video will then be played defining conjugate acid base pairs in Bronsted-Lowry acid base reactions using molecular models to illustrate this concept. Students will then be assigned practice problems for homework where they must identify conjugate acid base pairs in chemical reactions. The teacher will again circulate in class answering questions and checking answers to problems. Problems are due in the next class.
Week 3: The week begins with a review of the assigned problems by having students go to the whiteboard and explain how they identified the conjugate acid base pairs in an equation. Following this, the class will view a video that defines the Lewis acid base theory and illustrates examples using molecular models of this type of chemical reaction. Students will then be given several practice examples of Lewis acid base reactions to complete in class and then reviewed in class. A summative assessment is announced for the last class in the following week and a test outline will be distributed.
Week 4: Students will perform a titration experiment where the goal is to gather data to use in calculations to determine the concentration of a solution of hydrochloric acid. After the calculations are reviewed and handed in, a comprehensive review of the unit will take place in preparation for the unit summative assessment which will take place in either the last class of the week or the first class of Week 5.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. Honors Chemistry will be assigned more advanced problems as practice and assessment problems such as identifying Lewis Acids and Bases in an equation and drawing a molecular model of the (analyte) product that is produced in the reaction.

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Arrhenius Theory and pH Formative Quiz

1. Define or explain the Arrhenius Theory of Acids and Bases 10 points

2. Calculate the pH of a solution where $[H^{+1}] = 5.68 \times 10^{-10}$ M. Is this solution acidic or basic? 10 points

3. Calculate the pH of a solution where the $[H^{+1}] = 2.31 \times 10^{-4}$ M. Is this solution acidic or basic 10 points

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Unit 7 Summative Assessment

1. a. Calculate the $[H^{+1}]$ in a solution if the $[OH^{-1}]$ in the solution is 3.67×10^{-4} M 10 points

b. Calculate the $[OH^{-1}]$ in a solution if the $[H^{+1}]$ in the solution 7.89×10^{-8} 10 points

2. a. Calculate the pH of a solution where the $[H^{+1}]$ is 3.63×10^{-6}. Is the solution acidic or basic and is the solution weak or strong? 10 points

b. Calculate the pOH of a solution where the $[OH^{-1}]$ is 2.96×10^{-11}. 10 points

c. The pOH of a solution is 2.53 Calculate the pH of this solution 10 points

d. Calculate the $[H^{+}]$ in the solution described in part c above. 10 points

3. Identify the Bronsted Lowry acids and bases of the reactants in the equations below:

a. H_2O + S^{-2} → HS^{-1} + OH^{-1} 10 points

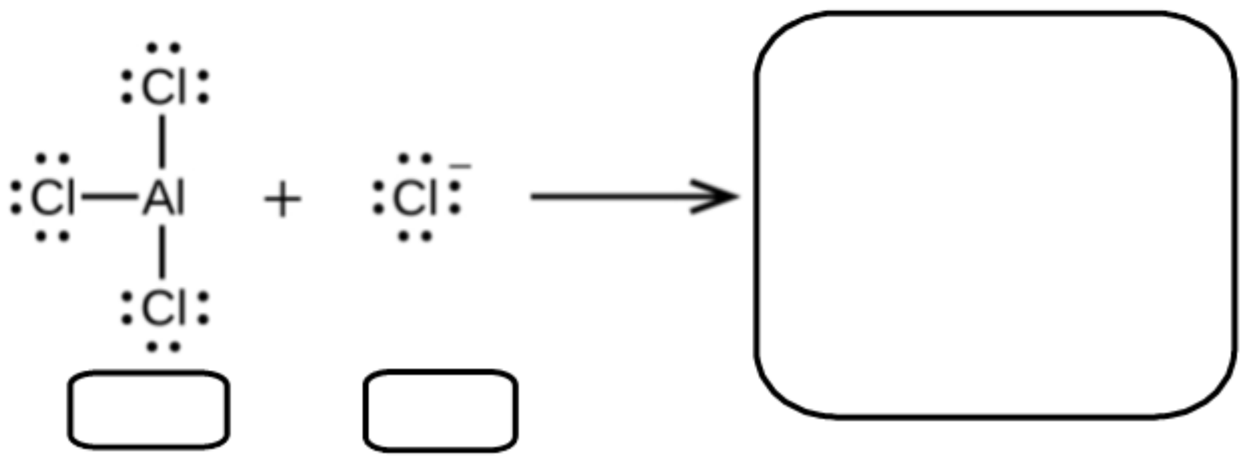
b. $CN^{-1}_{(aq)}$ + $HC_2H_3O_{2(aq)}$ ßà $C_2H_3O_2^{-1}{}_{(aq)}$ + $HCN_{(aq)}$ 10 points

c. Identify the Bronsted-Lowry acid/base conjugate pairs in the equations of parts a and b above.

(a) 10 points

(b) 10 points

4. Identify the Lewis Acid and Lewis base in the two equations that follow. Also draw the structure of the product (analyte) in each equation in the spaces provided 12 points each (total points in this problem = 24)



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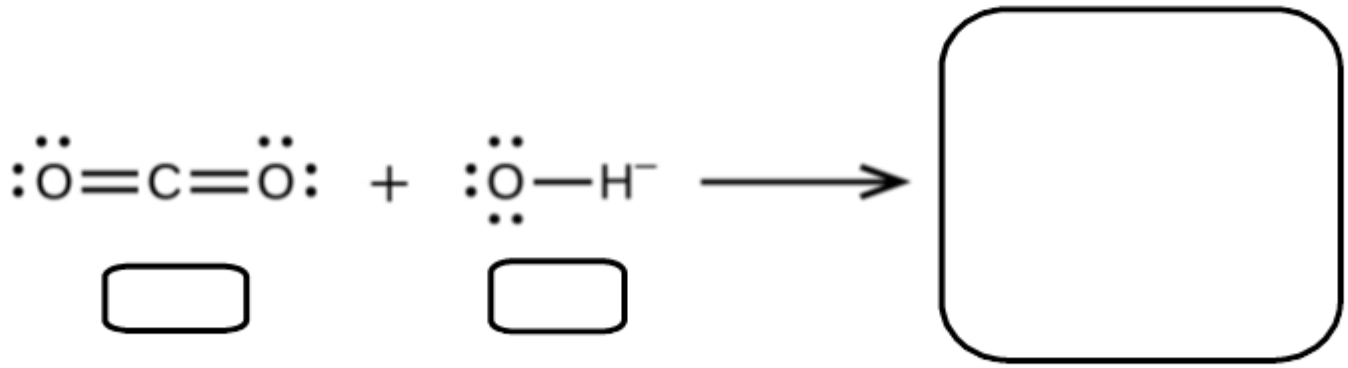

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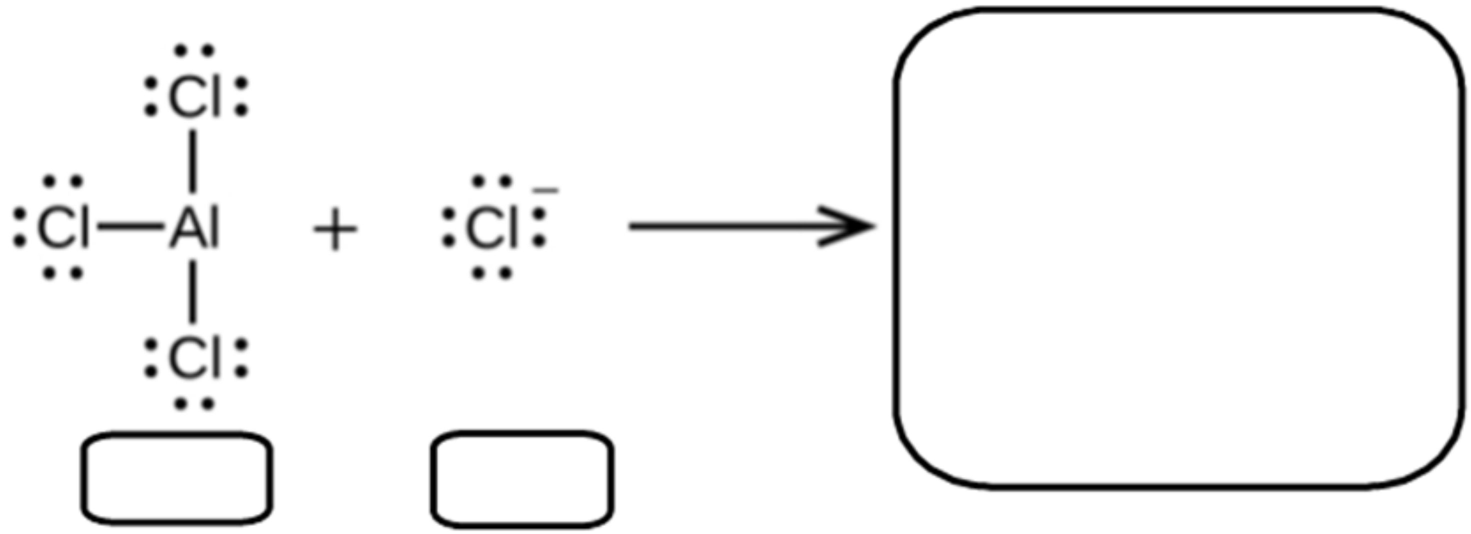

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Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 8: Rate of Reactions and Chemical Equilibrium
Pacing	4 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the tex

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system. Students will also be familiar with scientific calculators and how to use the scientific calculator for calculations involving exponents.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to interpret reaction coordinate graphs to determine activation energy of uncatalyzed and catalyzed chemical reactions. They must also be able to identify a reaction as either an exothermic or endothermic reaction from the reaction coordinate graph.	1. Students must know that chemical reactions have a minimum energy requirement to begin the reaction called activation energy. A catalyst creates a reaction mechanism with multiple steps, each with lower activation energies, rather than a one-step reaction with a significantly higher activation energy. In exothermic reactions, the reaction coordinate graph will show that the products will contain less energy than the reactants. The difference in the energy between the reactants and products is the amount of energy contained in the reactants that is given off in the reaction. In an endothermic reaction, the reaction coordinate graph will show that the products contain more energy than the reactants. The difference in the energy is the amount of energy absorbed by the products in the reaction.

2. Students must be able to explain why changes in temperature of reactants or the concentration of the reactants will change the rate at which a reaction will occur.	2. Students must know that an increase in temperature of reactants causes an increase in the average kinetic energy of the reactant particles. This increase results in more collisions of the reactant particles that result in a reaction to occur. A decrease in temperature will result in a decrease in the average kinetic energy of the reactant particles which results with fewer collisions between the reactant particles Fewer collisions resulting in a slowdown of the rate of reaction. An increased concentration of the reactant particles will decrease the average distance between reactant particles therefore increasing the number of collisions between reactant particles, resulting in more reactions between the particles. A decrease in concentration of the reactant particles increases the average distance between reactant particles resulting in fewer collisions of the reactant particles therefore decreasing the number of reactions between particles.
3. Students must be able to describe what is meant by equilibrium in a chemical reaction.	3. Students must know that equilibrium in a chemical reaction means that the rate of the forward reaction (reactants→ products) is equal to the rate of the reverse reaction (products→ reactants). This assumes that the reaction is reversible. As more products are produced, the rate of the reverse reaction increases will become equal to the rate of the forward reaction. Students must also know that a reaction at equilibrium does not mean there are equal amounts or concentrations of reactants and products.
4. Students must be able to calculate an equilibrium constant for a reaction given the concentrations of the	4. Students must know that the concentration of reactants

reactants and products are at equilibrium and at a stable temperature.	and products are stable, but not necessarily equal, in a reaction at equilibrium at a stable temperature. They must also know the generic equation to calculate the equilibrium constant. Given a generic chemical reaction at equilibrium: aA + bB <=> xX + yY, the equation to calculate the equilibrium constant is $K_{eq} = [X]^x [Y]^y / [A]^a [B]^b$ The capital letters in [ ] represent the concentrations of the reactants and products at equilibrium and the lowercase letters represent exponents. These exponents outside the [] are the coefficients of the reactants and products in the balanced chemical equation
5. Students must be able to use Le Chatelier's Principle to make qualitative predictions of changes in a chemical reaction at equilibrium when changes such as concentration of a product or reactant or a change in temperature are made.	5. Students must know that Le Chatelier's Principle states that when a stress is placed on a chemical reaction at equilibrium, such as a change in the concentration of a reactant or product, or a change in temperature, processes occur that tend to counteract the changes and bring the reaction to a new equilibrium. These processes involve changes in either forward or reverse rates of reaction that will bring the reaction to a new equilibrium.
6. Students must know what IRE charts are and how they are used to determine equilibrium concentrations and K_{eq} in a chemical reaction at equilibrium.	6. IRE charts organize the Initial moles/liter, Reacting moles/liter and Equilibrium moles/liter of reactants and products. These charts use initial given information, and stoichiometric calculations to determine reacting moles/liter and equilibrium moles/liter to calculate the K_{eq} for an equilibrium reaction.
7. Students must be able to calculate the value of K_{eq} when	7. Students must know how to set up a three-level table

given a balanced, reversible, chemical equation and given information about the initial moles of each reactant that are placed in an empty one-liter container and allowed to react to reach equilibrium. Students will also be given the concentration (moles/liter) of the product(s) in the container at equilibrium.	(IRE Chart) of the given information (initial moles/liter, reacting moles/liter and equilibrium moles/liter) for each reactant and product and be able to use simple stoichiometric calculations, as needed, to determine reacting moles/liter of reactants and product. Equilibrium moles/liters of the reactants can then be calculated using subtraction of reacting concentrations from initial concentrations. Knowing all equilibrium concentrations, students will then use the equilibrium concentrations to calculate K_{eq} for the reaction.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can the rate of a chemical reaction be controlled?	1. The rate of a chemical reaction can be controlled by numerous factors, such as temperature, concentration, pressure, particle size or catalysts.
2. What is the role of energy in chemical reactions?	2. Chemical reactions require a minimum amount of energy to start called the activation energy. Also, changes in temperature can cause changes in the average kinetic energy of atoms and molecules. If the temperature is increased, the average kinetic energy of atoms or molecules increases. Increased average kinetic energy causes collisions between particles with greater force which results in more reactions between the particles, If the temperature is lowered, the opposite results occur: Decreasing average kinetic energy, collisions of particles with less energy occur, resulting in fewer reactions between particles.

3. What is a reversible chemical reaction? 4. What does it mean to have a chemical reaction at equilibrium? 5. What are IRE charts and how are they used to determine equilibrium concentrations?	3. A reversible chemical reaction reacts in two directions at the same time. They react from reactants to products and products to reactants at the same time. 4. A reversible chemical reaction at equilibrium means that the rate of the forward reaction and the rate of the reverse reaction are equal. 5. IRE charts are three level charts that organize the Initial moles/liter, Reacting moles/liter and Equilibrium moles/liter of reactants and products. These charts use initial given information, and stoichiometric calculations to determine reacting moles/liter and equilibrium moles/liter to calculate the K_{eq} for an equilibrium reaction.

Resources

Student Technology Integration and Correspondence to ISTE Standards:

1.1 Empowered Learner
Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1.2 Digital Citizen
Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond by E. Davis
- *Problem Solving for Chemistry* by Edward I. Peters

Online Resources / Websites:

- link to Introduction to equilibrium

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **activation energy** - the minimum amount of energy needed to activate or energize molecules or atoms so that they can undergo a chemical reaction or transformation.
2. **activated complex -** unstable arrangement of atoms that forms momentarily at the peak of the activation energy barrier.
3. **catalyst** - a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.
4. **Reaction coordinate graph** - A reaction coordinate diagram is a graph that shows the relationship between energy and reaction progress.
5. **reversible reaction -** reaction in which the conversion of reactants to products and the conversion of products to reactants occur simultaneously.

6. **Equilibrium position -** describes the relative concentrations of reactants and products when a chemical reaction reaches equilibrium.

7. **Equilibrium -** a reversible chemical reaction in which the rate of the forward reaction is equal to the rate of the reverse reaction.

8. **Forward reaction -** in a chemical reaction at equilibrium, reactants producing products is the forward reaction.

9. **Reverse reaction -** in a chemical reaction at equilibrium, products producing reactants is the reverse reaction.

10. K_{eq} - the ratio of the mathematical product of the concentrations of the products of a reaction to the mathematical product of the concentrations of the reactants of the equilibrium reaction. Each concentration is raised to the power of its coefficient in the balanced chemical equation. $K_{eq\ i}$ is called the equilibrium constant.

11. **IRE chart** - an acronym for a three-level chart that includes data on concentration in moles/liter of reactants and products that male it possible to calculate the K_{eq} for a chemical reaction at equilibrium.

12. **collision theory -** a brief event in which two or more atoms/molecules come together in a collision that may possibly react with each other.

13. **Le Chatelier's Principle - the** principle that states that if any change is imposed on a reaction that is in equilibrium, then the reaction tends to adjust to a new equilibrium counteracting the change.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Learning Tasks Per Week (Including Instructional Strategies)
Week 1: After a demonstration of a phenomenon where two colorless solutions are mixed together in a flask and in approximately 30 seconds a sudden color change of the entire mixture of solutions turns from clear to blue/black occurs. Students will be asked to explain what might have happened. Following a brief discussion of student responses, the teacher will write a series of chemical

equations representing the steps in the reaction that occurred in the flask. . Students will then perform an experiment, using the same solutions, to determine the effect of changing temperatures and concentration of the solutions on the time required for the same color change to be observed. Discussion about results and conclusions about this experiment will take place in the next class. Sample reaction coordinate graphs will then be distributed to the class. The teacher will demonstrate how to analyze the energy changes in a reaction coordinate graph. Time will then be given for students to analyze the distributed sample reaction coordinate graphs and then individual students will be asked how they determined the activation energy of the reaction, whether the reaction is exo or endothermic and if the reaction will occur spontaneously or will be difficult to proceed without adding energy to reach the activation energy. The teacher will then distribute a sample of a catalyzed reaction, while defining the role of a catalyst. An analysis of the catalyzed reaction coordinate will be done by the teacher. A formative assessment on analysis of reaction coordinate graphs was announced for the next class period. and students were assigned to prepare for it.
Week 2: The reaction coordinate graph formative assessment will take place at the beginning of the first class of the week. The quiz will be graded, recorded, and returned to students while students view an introductory video on Chemical Equilibrium. The quiz questions will be then reviewed, and questions answered. Following the review of the quiz, notes will be given on equilibrium including how to calculate the value of an equilibrium constant. Demonstration problems of this calculation will be done by the teacher including, if needed, how to use exponents on a calculator. Students will then be given practice problems (and homework) to work on in class. The teacher will circulate among the students to answer questions, check answers, and show use of a calculator when using exponents if needed by some students. In the next class, assigned problems will be reviewed and a demonstration covering Le Chaelier's Principle will take place using solutions. Copies of an experiment to determine the equilibrium constant for a chemical reaction will then be distributed and procedures such as serial dilution of a solution, and how depth ratios of solutions in vials of equilibrium reactions are used to determine concentrations of products of the reaction.
Week 3: The students will begin the week performing the experiment that was distributed in the previous week. Time will be taken in the next class period to work with the groups of students (who worked together on the equilibrium experiment) to guide, as necessary, with calculations using the data they collected in the previous class. When calculations are completed, students will be given a series of questions about the lab including objectives, how the calculations lead to accomplishing the objects and the final result of the calculation of the equilibrium constant. Completed questions will be due in the next class period, discussed and reviewed. Students will be given a test outline for a Unit 8 summative assessment and a test date in week 4 was announced.
Week 4: A comprehensive review of Unit 8 will take place early in the week in preparation for the Unit 8 summative assessment.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

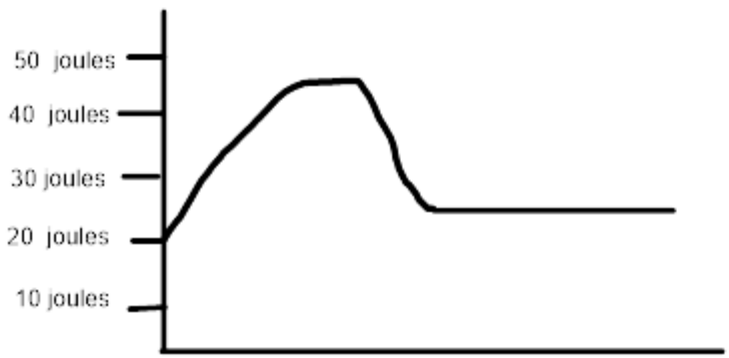
Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example the use of **IRE charts** to calculate K_{eq} using limited given information.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

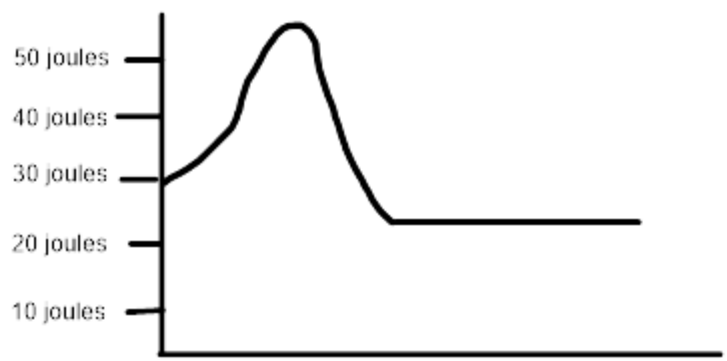
Formative assessment - reaction coordinate graphs

Analyze the following reaction coordinate graphs. Identify and calculate the activation energy and determine if the reaction is exothermic or endothermic. ten points each Total points= 20 points

1.



2



Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Unit 8 Reaction Rate and Equilibrium Summative Assessment

Directions: Answer all questions/problems that follow. You must show your math if a problem requires calculations in order to receive credit.

1. What two quantities that must be measured to establish the rate of a chemical reaction and cite several factors that affect the rate of a chemical reaction. 10 points

2. Use the atomic or molecular collision theory to explain what would happen if the following changes of conditions occurred in the chemical reaction below.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2$$

a. Increase the temperature of the reaction 10 points

b. Increasing the concentration of $C_6H_{12}O_6$ 10 points

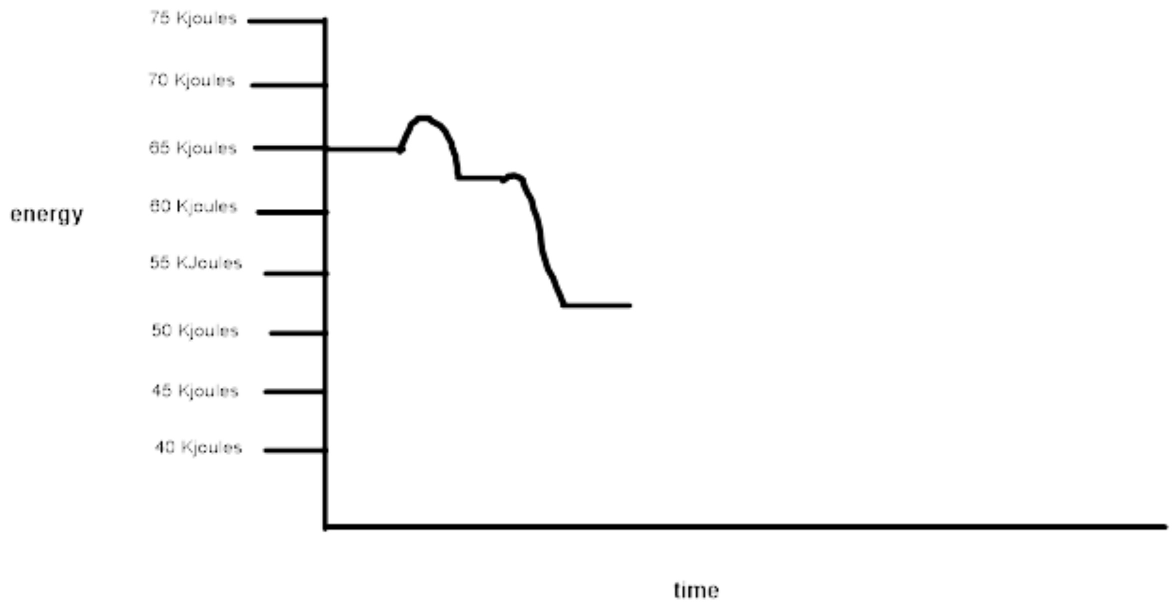
c. Decreasing the concentration of O_2 10 points

d. Decreasing the temperature of the reaction   10 points

3. Use the reaction coordinate graph below to answer the following questions.
   a. What is the value of the activation energy for this reaction? 10 points

   b. Is the reaction exothermic or endothermic? Explain your answer. 10 points

   c. Does this reaction have a catalyst involved? Explain your answer. 10



points

4.a. Given the reaction below at equilibrium.

$$2H_{2\,(g)} + O_{2\,(g)} \;<=>\; 2H_2O_{(g)}$$

At equilibrium, the concentrations of the reactant and products are: H_2 3 moles/liter. O_2 1 mole/liter and H_2O 2 moles/liter. Calculate the value of K_{eq}. 10 points

4 b. Given the reaction below at equilibrium.

$$2\ SO_{2\,(g)} + O_{2\,(g)} \Leftrightarrow 2\ SO_{3\ 9g)}$$

At equilibrium, the concentrations of the reactants and products are:

SO_2 3.00×10^{-3} moles/liter

O_2 3.50×10^{-3} moles/liter

SO_3 5.00×10^{-2} moles\/liter

Calculate the value of K_{eq} 15 points

5. a. Given a generic chemical equation at: $A + 3B \Leftrightarrow 2C$

Four moles of A and 8 Moles of B are allowed to react in a one-liter container. When the reaction reaches equilibrium 4 moles of C are present in the container. Using an IRE chart, calculate the value of K_{eq} for this reaction. 15 points.

5. b. 8.2 moles of O_2 and 8.0 moles of NO are placed in a 1 liter container and allowed to react until equilibrium is reached according to the following equation: $2\ NO + O_2 \Leftrightarrow 2\ NO_3$

When equilibrium is reached, the [NO] is 3.2 moles/liter. Using an IRE chart, calculate the value of K_{eq}. 20 points.

6. Describe the process that would happen in a reversible reaction that starts and reaches equilibrium. 10 points

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 9: Thermochemistry and Nuclear Chemistry
Pacing	3 Weeks

CT State Standards *What are the goals of this unit?*
Priority/Focus Standards: **Reading** 1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. 5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation, and dimensional analysis in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to calculate the amount of energy gained or lost of a known mass of a substance that undergoes a change in temperature.	1. Students must know the equation $\underline{q = mc\Delta t}$. q represents a quantity of heat energy gained or lost, m represents the mass in grams of a substance, c represents specific heat and Δt represents the change in temperature.
2. Students must be able to experimentally determine the specific heat of a sample of a metal.	2. Students must know how to construct a calorimeter, using Styrofoam cups, a thermometer, and cardboard. A calorimeter is an insulated device used to measure temperature changes in a substance. Students must also know that specific heat is the amount of heat lost or gained to change the temperature of one gram of a substance by one degree Celsius.
3. Students must be able to calculate the heat lost or gained	3. Students must know what a "heat of formation" of a

in a chemical reaction using Hess's Law. Students must be able to use Hess's Law to calculate the overall heat of reaction also known as ΔH.	compound is and how to apply this numerical information in Hess's Law to calculate the value of the heat of reaction. (ΔH)
4. Students must be able to identify a chemical reaction as exothermic or endothermic based on the result of a calculation of ΔH of the reaction using Hess's Law.	4. An exothermic reaction releases energy from the during the reaction and has a negative value of ΔH while an endothermic reaction absorbs energy and has a positive value for ΔH
5. Students must be able to define radiation.	5. Radiation is the emission of particles or energy from the nucleus of an atom in the process of becoming more stable.
6. Students must be able to identify the different types of radiation and the changes that take place in the nucleus of a radioactive atom because of being radioactive.	6. Alpha radiation particles are composed of two protons and two neutrons. When emitted from the nucleus of an atom, the atomic number of the atom decreases by two and its atomic mass number decreases by four. Beta radiation particles are formed in the nucleus of an atom when a neutron loses an electron that is then emitted from the atom, leaving an additional proton in the nucleus. The atomic number increases by one and the atomic mass number remains unchanged. Gamma radiation, a very high energy form of light, when released from the nucleus of an atom, lowers the energy level of the nucleus making it more stable.
7. Students must be able to define half-life.	7. A half-life is the time that it takes for half of an original amount, or some amount of a radioactive element, to decay.
8. Students must be able to perform a series of multiple	8. Students must know the changes in the nucleus of an

radioactive decays of a radioactive element making a poster model of the changes in the nucleus of an atom and the resulting atom's identity in each step of the decay. 9. Students must be able to determine the remaining amount of an element after a specified number of half-lives, given the half-life of the radioactive element, the time span of the decay process. and the original amount of the element. 10. Students must be able to draw a diagram and write an explanation of what occurs in nuclear fission and nuclear fusion.	atom that occur in alpha and beta decay and the overall change in the resulting atom, including the identity of the atom. 9. Students must know how to draw a flowchart diagram illustrating the amount of a radioactive element after one half life. This is repeated for the specified number of given half-lives. 10. Students must know the differences between nuclear fission and nuclear fusion: what types of atoms are involved in these processes, how the reactions are started, what, if any, waste is produced, and the comparative energy produced in each process.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do we determine the amount of heat absorbed or released in a temperature change of a substance not involved in a chemical reaction? 2. How do we determine the heat absorbed or released in a chemical reaction?	1. Calculation of the quantity heat indicates the heat energy is being absorbed or released by a substance undergoing a temperature change. This requires using the specific heat of the substance, mass of the substance and knowing the temperature change that takes place. 2. Hess's Law uses heats of formation of the reactant chemicals and chemical products of the reaction to calculate the heat of reaction known as ΔH. A negative value of ΔH indicates that heat energy is being released because of the reaction and a positive value of ΔH

	indicates that heat energy is being absorbed during the reaction.
3. What are the types of radiation that can be emitted from the nuclei of atoms?	3. Radiation that can be emitted from the nuclei of atoms includes alpha particles, beta particles, positrons and gamma waves. Alpha (<u>α</u>) particles are composed of 2 protons and 2 neutrons. Beta (**β**) particles are high speed electrons emitted from the nucleus of an atom. Positrons (**β**+) are positive subatomic charged particles with the same mass and magnitude of charge as an electron. It is sometimes referred to as an anti-electron particle. Gamma (ɣ) radiation is a very high energy light having very short wavelengths and very high frequencies.
4. What is radioactive decay?	4. Radioactive decay is the process in which a radioactive atom spontaneously gives off radiation in the form of particles or energy to reach a more stable state and also resulting in a different element that is more stable. An atom can undergo multiple decays to eventually reach a stable condition.
5. What elements undergo radioactive decay?	5. Radioactive decay is seen in all isotopes of all elements of atomic number 83 (bismuth) or greater.
6. What are types of radioactive decay?	6. The types of radioactive decay are alpha decay. beta decay and gamma decay. Alpha decay emits an alpha particle from the nucleus of a radioactive element. The result is a decrease in the atomic number of the new element formed in the decay by two and the mass of the new element decreasing by four. Beta decay involves a

	neutron in the nucleus emitting a beta particle, leaving a remaining proton. This results in the atomic number of the new element formed in the decay increasing by one with the atomic mass remaining unchanged.
7. What is a half-life of a radioactive element?	7. A half-life of a radioactive element is the amount of time it takes for one half of an amount of a radioactive element to undergo radioactive decay.
8. What is the difference between nuclear fission and nuclear fusion?	8. Fission is the splitting of a heavy, unstable nucleus by a neutron into two lighter nuclei, and fusion is the process where two light nuclei are fused together releasing vast amounts of energy. Nuclear fission produces very large amounts of energy and many radioactive waste particles. Fission also releases neutrons to continue a chain reaction of more atoms undergoing fission. On the other hand, nuclear fusion releases multiple times the amount of energy compared to fission and does not produce radioactive waste. To start a fusion reaction, very large amounts of energy are needed, such as the energy from a fission reaction, to start and then continue the fusion process. This energy is required to overcome the force of repulsion of the protons in the nuclei of the fusing atoms.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1.2 Digital Citizen
Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* by Edward I. Peters

Online Resources / Websites:
- half life problem solving video
- Nuclear chemistry PowerPoint

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **calorie -** The amount of heat required to raise the temperature of one gram of water 1.00 degree Celsius.

2. **joule -** a unit of heat energy. One calorie = 4.184 joules.

3. **specific heat -** The amount of heat energy required to raise the temperature of one gram of a substance one degree Celsius.

4. **enthalpy -** The measurement of energy in a thermodynamic system, such as a chemical reaction. The quantity of enthalpy equals the total content of heat energy of a system.

5. **endothermic reaction - A** chemical reaction that absorbs heat from its environment.

6. **exothermic reaction -** A chemical reaction that releases heat into its environment.

7. **Hess's Law -** Allows the enthalpy change (ΔH) for a chemical reaction to be calculated even when it cannot be measured directly. This is accomplished by performing basic algebraic operations based on the balanced chemical equation of a reaction. The equation for Hess's Law is: $\Delta H = \sum H_f$ of the products - $\sum H_f$ of the reactants. (H_f is the heat of formation of a compound) and ΔH is the total amount of heat either absorbed in or released from a chemical reaction. (the symbol $\sum$ means "the sum of".)

8. **heat of formation -** The amount of heat absorbed or released when one mole of a compound is formed from its needed elements, each substance being in its normal physical state (gas, liquid, or solid).

9. **radioactive decay -** The process where a radioactive atom spontaneously emits radiation in the form of particles or light energy to become more stable.

10. **alpha decay -** A form of radioactive decay where an atom emits an alpha particle from its nucleus. An alpha particle is composed of two protons and two neutrons.

11. **beta decay -** A form of radioactive decay where an atom emits a beta particle from its nucleus. A beta particle is the result of a neutron in the atom's nucleus emits a high energy electron. This results in an increase of one proton in the nucleus which changes the identity of the atom. The atomic mass number does not change.

12. **gamma decay -** A process where the nucleus emits energy in the form of gamma waves of light. Gamma light is very high in energy because of its very high frequency and very short wavelength.

13. **positron -** A beta particle that has a positive charge ($\boldsymbol{\beta}^{+1}$) and the same mass as an electron. It is sometimes described as an anti-electron.

14. **half Life** - the amount of time it takes half of a number of radioactive atoms of an element to decay to a more stable condition.

15. **nuclear fission -** A process where a heavy and large radioactive atom is split into two or more smaller and lighter atoms after being struck by a neutron. A large amount of energy is released in nuclear fission. The splitting of the atom also releases neutrons that can strike other atoms and cause fission of them. If the concentration of fissionable atoms is high enough, a very fast chain reaction of fission will occur where large numbers of neutrons are emitted and split other atoms which also release more neutrons to continue the process of fission to continue very rapidly.

16. **critical mass -** The minimum number of fissionable atoms that will support a self-sustaining chain reaction of nuclear fission. At this mass, the neutrons released as a product of one fission reaction can cause neighboring atoms to fission.

17. **nuclear fusion -** A process where the nuclei of two small, light atoms are forced to fuse together to produce a larger heavier atom. Fusion requires a very large amount of energy to be applied to the two fusing nuclei and cause them to fuse together. Nuclear fusion produces multiple times the amount of energy that nuclear fission and no radioactive waste as produced in fission.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)
Week 1: After an introduction to heat measurement and the equation $q = mc\Delta t$, students will perform a lab experiment requiring they construct a calorimeter and determine the specific heat of a sample of an unknown metal and identify the metal using their calculated value of the specific heat. The next class will be used to review the lab results. Following the review, notes will be given on how to use Hess's law to calculate the heat of reaction. Practice problems will be assigned and due the first class of week two. This will be followed by performing an experiment to determine the heat of reaction of a reaction between an acid and a base, with the calculations and results of the lab due by the second class of week two.
Week 2: This week begins with a review of the Hess's Law practice problems assigned last week. Students will then be assigned to write a minimum of two pages research paper on the history of the use of radiation in medicine. The paper will be due in the next

class period. This will be used as a formative quiz leading into the section of this unit dealing with nuclear chemistry. Students will be given time to begin their research for the paper during class. Students will be informed that the Unit summative assessment will take place at the end of week three.

Week 3: The students will be shown the nuclear chemistry PowerPoint presentation. The video about half life will also be shown during the and practice problems regarding half-life will be done. Following this, the class will be given a test outline for a summative assessment on thermochemistry and nuclear chemistry. A comprehensive review for the summative test will then be done. As previously announced, the summative assessment will take place in the last class of the week.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, an equation to use in solving half-life problems will be taught. The equation includes the use of *natural logs* rather than logs.

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

History of the Use of Radiation in Medicine Paper

Directions: Your task is to write a research paper on the history of the use of radiation in medicine. The paper must be a minimum of 2 pages in length and also include a listing or your sources of information.

The research paper should include dates of the medical use, the types of radiation employed, the source of the radiation, and the names of any physicians that used it, if available. It should also include what medical conditions were treated with it.

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Summative Assessment of Unit 9
Thermochemistry and Nuclear Chemistry

Directions: You must show all work when solving problems and answers must be labeled with units in order to receive credit for the problem!

1. a. How much heat is required to raise the temperature of 204 grams of lead from 22.8 'C to 64.9 'C?
   8 points

   b. To what temperature will 454 grams of nickel be raised or lowered, if, beginning at 45.0 'C it loses 3138 joules of heat? 8 points

2. Calculate ΔH for each of the following chemical reactions and identify them as exothermic or endothermic.

a. $2\ NO_{(g)} + O_{2\,(g)} \longrightarrow 2\ NO_{2\,(g)}$, 20 points

b. $Fe_2O_{3\,(s)} + 3\ CO_{(g)} \longrightarrow 2\ Fe_{(ss)} + 3\ CO_{2\,(g)}$ 20 points

3. Compare the properties of alpha particles and beta particles. 15 points

4. An atom of 92 ^{238}U undergoes the following series of radioactive decay - alpha, alpha, beta, beta, and finally alpha. Draw a flow chart diagram of each step in the series of decays including the element's symbol (with atomic number and atomic mass number) 20 points

5. a. The half-life of $_{30}^{71}$Zn is 2.4 minutes. If one had 500.0 g at the beginning time, how many grams would be left after 7.2 minutes has elapsed? 10 points

b. Oxygen (atomic mass number of 22) has a half-life of 2.25 seconds. How many half-lives would 500 grams Oxygen - 22 go through to end up with 7.81 grams of oxygen - 22 remaining? 15 points

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades: 10th and 11th / Honors/College Prep Chemistry
Unit of Study	Unit 1: The Structure of Matter and the Periodic Table
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:

Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction,

reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Math: Students will be able to perform calculations employing algebra, scientific notation, and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to create models of atoms correctly identifying the numbers and location of protons, neutrons, and electrons in the atom.	1. The periodic table of elements organizes all elements based on the number of protons in the nucleus, and an equal number of electrons. The atomic weight of an element also allows the calculation of the number of neutrons on the nucleus. There can exist atoms of an element with different atomic weight due to differing numbers of neutrons. The multiple atoms with differing atomic weight are referred to as isotopes.
2. Students must be able to write an electron configuration of an element.	2. Electrons are arranged around the nucleus of an atom based on energy levels that the electrons occupy. These energy levels, numbered 1 through 7, and their sequence are known as an electron configuration.
3. Students must be able to determine the number of valence electrons of an element in any of the eight main groups of the periodic table (groups 1, 2, 13, 14, 15, 16, 17 18)	3. Energy levels that electrons occupy may contain up to four sublevels (spaces that have the greatest probability of finding an electron) known as s, p, d, and f orbitals. Valence electrons are the electrons that occupy the s and p orbitals at the highest energy level in an atom.

4. Students must be able to identify some of the properties of an atom of an element using their location on the periodic table.	4. The periodic table arranges elements based on being metals, nonmetals, and metalloids. There are also trends in specific properties of elements on the periodic table. These properties include electronegativity, atomic radius, and ionization energy, among others.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can one explain the structure and properties of matter? 2. How is the Periodic Table of Elements organized and arranged according to properties of the elements?	1. Matter is composed of extremely small particles called atoms and these atoms are composed of subatomic particles, positively charged protons, neutrally charged neutrons, and negatively charged electrons. The protons and neutrons are found in a very small, dense cluster in the center of the atom called the nucleus. Protons and neutrons have approximately the same m while electrons have mass of approximately 1/1800th of a proton. The identification of the atoms is based on the number of protons, its properties are determined by the electrons and neutrons and protons contribute almost 100% to the mass of an atom.

Resources

Student Technology Integration and Correspondence to ISTE Standards:

- 1.1 Empowered Learner
- Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning science.

- 1.2 Digital Citizen

Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical**.**

- 1.5 Computational Thinker
  Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson.
- *Modern Chemistry* by Raymond E. Davis.
- *Problem Solving for Chemistry* Edward I. Peters

Online Resources / Websites:

- Khan Academy - Introduction to electron configurations.
  - https://www.astronomy.ohio-state.edu/pogge.1/TeachRes/HandSpec/atoms.html emission spectra of visible light of chemicals

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. amu - atomic mass unit.

2. atom - the smallest identifiable particle of an element.

3. accuracy - how close a measurement or calculation is to the actual answer.

4. precision - how close multiple measurements or the same calculations are compared to the actual answer.

5. proton - a subatomic particle having a positive electrical charge and found in the nucleus of an atom.

6. neutron - a subatomic particle with a neutral electrical charge found in the nucleus of an atom.
7. electron - a subatomic particle arranged in energy levels around the nucleus of an atom.
8. periodicity - repeating patterns and trends of properties of elements on the periodic table.
9. family - a vertical column of elements on the periodic table.
10. group - the same as a family on a periodic table.
11. main groups - columns 1, 2, 13, 14, 15, 16, 17, 18 (alternative Roman Numerals I through VIII) on the periodic table.
12. alkali metals - group number 1 on the periodic table (except for hydrogen).
13. alkali earth metals - group number 2 on the periodic table.
14. transition elements - groups 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 of the periodic table.
15. noble gasses - group 18 on the periodic table.
16. metalloids - the following elements compose the region on the periodic table known as the metalloids: antimony (Sb), germanium (Ge), silicon (Si), arsenic (As), tellurium (Te), polonium (Po), boron (B), and astatine (At). These elements align as a diagonal, staircase shaped, group extending from Boron to Polonium on the periodic table.
17. series - a horizontal row of elements on the periodic table. There are seven rows on the main part of the periodic table.
18. period - the same as a series on the periodic table.
19. energy levels - a scheme of how electrons arranged around the nucleus of an atom based on energy.
20. orbital - a three-dimensional space in an energy level that contains electrons.

21. suborbital - a three-dimensional subdivision of an orbital with greatest probability of containing an electron.

22. isotope - multiple forms of atoms of the same element that differ in the number of neutrons therefore also differ in mass.

23. electron configuration - an alphanumeric sequence of the energy levels and orbitals for electrons in an atom.

24. average atomic mass - a calculation of the atomic mass of an element based on the percentage of each isotope of the element.

25. s orbital - a single spherical space capable of containing a maximum of two electrons.

26. p orbital - a three dimensional space composed of three sub orbitals. Each sub orbital can contain a maximum of two electrons for a total of up to six electrons in the entire orbital.

27. d orbital - a three-dimensional space composed of five sub orbitals. Each sub orbital can contain a maximum of two electrons for up to a total ten electrons in the entire orbital.

28. f orbital - a three-dimensional space composed of seven sub orbitals. Each sub orbital can contain a maximum of two electrons for up to a total 14 electrons in the entire orbital.

29. lanthanide series - consists of elements with atomic numbers 57 to 71 on the periodic table. This row of elements is most located beneath the main body of the periodic table. The lanthanides are a part of series number 6.

30. actinide series - consists of elements with atomic numbers 89 to 103 on the periodic table. This row of elements is most located beneath the main body of the periodic table, below the lanthanide series. The actinides are a part of series number 7.

31. ground state - the lowest energy level that an electron can occupy in an atom.

32. excited state - an energy level in an atom that an electron can jump up to after gaining an amount of energy.

33. electronegativity - a relative measure of the ability of an atom to attract and hold onto electrons.

34. ionization energy - the amount of energy required to remove an electron from an atom,

35. atomic radius - the distance from the center of an atom's nucleus to an outermost electron in the energy levels surrounding

the nucleus.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Learning Tasks Per Week (Including Instructional Strategies)
Week 1: Explanation of course outline and expectations, lab safety and pointing out safety devices in lab, followed by Lab Safety reading assignment. Quiz on safety will take place in the next class session. Students must score 85% or higher to perform lab experiments. Quizzes will be kept on file documenting student awareness of lab safety devices and procedures. A review of qualitative and quantitative observations followed by an activity "Observations of a Burning Candle". This activity will require students to classify their observations as qualitative or quantitative and write a chronological essay of all their observations. Students will self-evaluate their essays by comparing it to a professional scientist's similar essay, with class discussion.
Week 2: A review of the metric system of the units of mass, length, and volume employing a graphic representation of the subdivisions of the base units of metric measurement. Practice problems of metric conversions of base units to subdivisions will take place in class followed by a formative "open note" formative quiz on metric conversions of subunits. A reference sheet of conversions from metric to other systems of measurement (inches, feet, miles, ounces, pounds, pints, and quarts, and gallons etc. will be distributed and reviewed, the reference sheet is to be kept by the students. The "factor label "aka "dimensional analysis' ' method of problem solving will be introduced by making conversion of metric units into subunits and converting metric units of measurement into other systems of measurement or vice versa. A notes outline will be distributed with demonstration and practice problems for this lesson. Rules for determining "significant figures "and rounding off will be distributed as a reference sheet, reviewed, and include practice problems to be done in class and discussed. The week will end with an activity where students will differentiate between accuracy and precision in experiments and how these two properties relate to each other.
Week 3: A summative assessment on the topics covered in the first two weeks will take place at the beginning of Week Three. As an opening exercise, Students will be given a pre quiz on the Periodic Table of Elements. This quiz will be repeated several times as the class explores the periodic table in this unit. A lecture covering the structure of an atom will take place. Following the lecture, students will be tasked with drawing a color-coded model of an atom of an element depicting its structure. The models will be displayed on the whiteboard for students to do a gallery walk followed by class discussion about the models. A basic periodic table will be distributed to students and the information included in the squares for each element will be reviewed. A lecture will take place discussing isotopes and calculation of average atomic mass, followed by classroom practice problems and an assignment

of problems as homework. Assigned homework will be reviewed in the next class. Following this review, a formative assessment will take place of problems about isotopes and calculating average atomic mass. Corrected summative assessment will be returned and reviewed at the end of the week.
Week 4: The week begins with a simple discussion of the traditional model of the arrangement of electrons around the nucleus of an atom (like the solar system). The "Light Saber" demonstration is then done as a phenomenon to introduce the quantum model of arrangement of electrons around the nucleus. Students will receive a packet that leads them through models of the energy level (quantum) model of the arrangement of electrons. The packet progresses from just energy levels, orbitals, sub orbitals, overlapping energy levels and the process of locating electrons in the correct sequence on this model. Students are guided through the process of placing electrons of several different elements of the main groups on this model. They are then instructed to place the electrons of each element in series 2 of the periodic table on a separate copy of the model. The quantum model is then used to derive the alphanumeric electron configuration of an atom's electrons. Practice writing electron configurations for a selection of elements from the periodic table and a corresponding assignment for homework. The week will end with the class engaging in an" Electron Configuration Challenge". The goal of the challenge is to write an accurate and complete electron configuration, from memory only, faster than the teacher. Pending results of the challenge, students could receive a bonus (formative assessment) quiz grade up to 100 points. Students will perform a "Flame Test" experiment to observe the emission spectrum of four metal salt solutions and identify the metal ions in solution from the spectrum. The experiment may overlap slightly into the next week.
Week 5: This week will focus on the regions of the periodic table, names and numbering of families, numbering of series, and trends of the properties of electronegativity, ionization energy and atomic radius on the periodic table. Given a blank periodic table. students will be given the names of the regions of the periodic table and create a color-coded model of them on the blank periodic table. They will also be given the names of several families in the main groups of the periodic table and indicate them by their names. In addition to the above, the students will be given data tables and graphs of the three properties listed above. They must analyze the data and graphs, identify the general trends of these properties in both series and groups on a second blank periodic table. When completed, the completed period tables will be posted on a whiteboard and students will view them and compare them. to be given at the beginning of week six.
Week 6: A test outline of the unit test will be distributed, and a comprehensive review of the unit will take place for the unit summative assessment. The summative assessment of this unit will take place this week. The corrected exams will be returned and reviewed before starting Unit 2.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☐ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework
• Students will be applying math skills (critical thinking) in problem solving and use communication skills taught in other subject areas, such as ELA.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, in Unit 1, students in Honors Chemistry will be instructed in calculating energy level values. Energy will be gained and lost when an electron in an atom of hydrogen jumps from ground state to an excited state and returns to ground state. Using this information, students will also be able to determine the wavelength of light energy emitted when it returns to ground state, using the energy difference between ground and excited states utilizing a set of light equations calculations.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Name____ Date____________________ Period

Electron Configuration Formative Quiz

1, Write a full electron configuration for each of the elements below:

a. ${}_{2}^{4}He$

b. ${}_{8}^{16}O$

c. ${}_{17}^{35}Cl$

d. ${}_{26}^{56}Fe$

e. ${}_{36}^{54}Ar$

f. ${}_{58}^{140}Ce$

2. How many valence electrons are in each of the elements in question 1?

a.

b,

c.

d.

e.

f.

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Name: ____ Total points: 201 points

Atomic Structure Unit Test. Solve all problems that follow. Don't forget to label answers with appropriate units.

1. Summarize J.J Thomson's and Ernest Ruthurford's contributions to our understanding of the structure to an atom. 10 points

2. Determine the number of protons, neutrons, and electrons in each element below 2 points each (10 total points

element	protons	neutrons	electrons
$_{16}^{32}S$			
$_{20}^{40}Ca$			
$_{79}^{197}Au$			
$_{86}^{222}Rn$			
$_{90}^{232}Th$			

3. A. Calculate the average atomic mass in amu's of the three isotopes of Argon using the data below.

15 points

Isotope	mass	abundance
^{36}Ar	35.97 amu	0.337%
^{38}Ar	37.96 amu	0.0630%
^{40}Ar	39.96 amu	99.60%

B. Calculate the average atomic mass in amu's of the four isotopes of lead using the data below.

20 points

Isotope	mass	abundance
^{204}Pb	203.97 amu	1.40%
^{206}Pb	205.97 amu	24.01%
^{207}Pb	206.98 amu	22.10%

^{208}Pb	207.98 amu	52.40%

4.Write a full electron configuration for the following elements.

20 points (5 points each)

a. F

b. Ni

c. Rb

d. Eu

5.Write an abbreviated electron configuration for the following elements

20 points (5 points each)

a. C

b. V

c. Po

d. U

6. Calculate the energy of the following energy levels.

10 points (5 points each)

a. n=3

b. n=7

7. Calculate the wavelength of light emitted when an electron in the Lyman Series transitions from an excited energy level of n=6 to ground state. Also, is the light visible?

20 points

8. Calculate the wavelength of a light emitted when an electron in the Balmer Series transitions from an excited energy level of n=4 to ground state. Also, is this light visible?

20 points

9. a. What are the four quantum numbers for an electron in the 5 P_z sub-orbital with counterclockwise spin

8 points (2 points each

b. What are the four quantum numbers for an electron in the 7 S orbital with clockwise spin

8 points (2 points each)

c. What are the four quantum numbers for an electron in the $5f^9$ suborbital with counterclockwise spin?

8 points (2 points each)

d. What are the four quantum numbers for an electron in the 4 d ($x^2 - y^2$) sub-orbital with counterclockwise spin?

8 points (2 points each)

10. Write a description of an electron with the four quantum numbers: 8 points each for parts a, b, and c (total 24)

a. 2, 1, 0, +1/2

b. 6, 3, +2, -1/2

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11, Honors / College Prep Chemistry
Unit of Study	Unit 2: Chemical Bonding and Reactions
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a

problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection.

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS-1- 2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties**.**

HS-PS-1-3 Plan and investigate to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS 2- 6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students will be able to describe and draw a model of an ionic bond, covalent/polar covalent bond and metallic bond.	1. Bond formation between nonmetal atoms is dependent upon the difference in the property of electronegativity (the ability of an atom to attract and hold onto another atom). Specifically, students will calculate the difference in electronegativities of the two bonding nonmetal atoms and the magnitude of the difference will determine the type of bond that forms. Very low differences favor covalent bonding while large differences will cause ionic bonds. Metallic bonds are essentially the nuclei of metal atoms "floating in a sea" of electrons.
2. Students will be able to draw a Lewis Structure model of	2. A Lewis Structure model requires following a number of

a molecule or polyatomic ion composed of two or more atoms from the eight main groups of the periodic table.	steps that include knowing how to determine the total number of valence electrons of the atoms in the molecule and arrange the total number of valence electrons of the atoms in the molecules such that each atom is surrounded by a number of valence electrons that is the same as one of the Noble Gas elements (main group number 18 on the periodic table) commonly referred to as a complete octet.
3. Students will be able to identify a type of chemical reaction from a balanced equation representing the reaction amd predict the chemical formulas of products in chemical reactions.	3. There are six basic types of chemical reactions. They include: (a) synthesis, (b) decomposition, (c) single displacement, (d) double displacement, (e) combustion, (f) acid/base.
4. Students will be able to balance a chemical equation such that there are equal numbers of each atom in the reactants and products of the reaction.	4. The Law of Conservation of mass and atoms states that matter cannot be gained or lost during a chemical reaction.
5. Students will be able to construct two- or three-dimensional models of molecules and identify their geometric shape.	5. The geometry of molecules is determined by the repulsion of the individual bonds between the atoms composing the molecule.
6. Students will be able to explain why molecules have different geometric shapes using the VSEPR Theory	6. The **VSEPR** Theory (**V**alence **S**hell **E**lectron **P**air **R**epulsion) is a model used to predict the molecular geometry of a molecule or polyatomic ion based on the number of valence shell electron bonded pairs between the atoms of the molecule or polyatomic ion. This model assumes that electron pairs will arrange themselves to minimize or equalize repulsion between the bonded pairs of electrons.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why do most atoms form chemical bonds?	1. Most chemical bonds form by either transferring or sharing electrons between atoms.
2. How are ionic and covalent bonds formed and how does the bond type influence the properties of compounds?	2. Ionic bonds occur when electrons are transferred from one atom to another creating positive and negative ions that attract each other while covalent bonds form when a pair of electrons are shared between two atoms and attracted equally to the two atoms.
3. What is the format for representing a chemical reaction with a chemical equation?	3. A chemical equation is formatted such that the reacting chemicals are on the left side of an arrow which points to the right to the chemical products of the reaction.
4. How is the Law of Conservation used to balance chemical equations?	4. The Law of Conservation states that during a chemical reaction, matter can neither be created nor destroyed. The number of each atom in reactants must equal the number of atoms in the products.
5. What factors determine the geometric shape of a molecule?	5. The main factor influencing molecular geometry is the balance of repulsive forces of bonds between atoms that compose the molecule.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Informational Texts and/or Media: • *Chemistry: Principles and Reactions* by Hurley and Masterson • *Modern Chemistry* by Raymond E. Davis • *Problem Solving for Chemistry* Edward I. Peters **Online Resources / Websites:** • Google Slideshow - Chemical Bonding

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. ionic bond - a force of attraction caused by the transfer of one or more electrons from one atom to another creating a positively charged ion and a negatively charged ion which are strongly attracted to each other.

2. covalent bond - a force of attraction between two atoms created by a pair of electrons that are shared between the nuclei of the two atoms.

3. metallic bond - the nuclei of metal atoms are essentially immersed in and surrounded by mobile electrons.

4. ion - an electrically charged atom or group of atoms.

5. monatomic ion - an electrically charged particle composed of only one atom.

6. polyatomic ion - an electrically charged particle that is composed of two more atoms.

7. cation - a positively charged ion.

8. anion - a negatively charged ion.

9. reactants - Molecules or atoms that are interacting with each other and form new chemical bonds rearranging atoms to produce chemical changes and new chemical structures.

10. products - new chemical structures caused by formation of new chemical bonds and rearrangement of atoms in the reactants of a chemical reaction.

11. Law of Conservation - matter cannot be created or destroyed during a chemical reaction.

12. balanced chemical equation - a chemical equation where the number of atoms in the reactants is equal to the number of atoms in the products of the reaction.

13. Law of Multiple Proportions - This law states that the same atoms can bond in different whole number ratios to form molecules with different whole number ratios of each atom and different physical and chemical properties.

14. Lewis Structure - a model of a molecule or polyatomic ion based on the number of valence electrons of all the atoms. The electrons are arranged around the symbols of the atoms in the molecule or polyatomic ion to be the same arrangement of the electrons in a Noble Gas element known as a complete octet except for hydrogen having only two electrons.

15. metal salt - an ionic compound composed of metal and nonmetal ions.

16. solvent - a substance that will dissolve another substance.

17. solute - a substance that is dissolved in a solute.

18. solubility - a measure of how much of a compound will dissolve in a solvent.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: This week will include a slideshow that focuses on the role of electrons in forming chemical bonds and describing how to identify the different types of chemical bonds. Students will be given notes outline to accompany the slideshow presentation. As part of the presentation, students will be instructed to draw models of the three basic types of chemical bonds based on a verbal description. As the week continues, the slide show focuses on what Lewis Structures are and how to draw them. A student handout will be distributed listing summarized steps for drawing the structures. Several examples of molecules and polyatomic ions are included on the handout and will be done as demonstration samples of creating these structures. Students will then work on practicing Lewis Structure problems. The problems will then be reviewed and a short formative quiz consisting of several problems will be given. Students will be allowed to use the Lewis Structure handout during this quiz. The week will end with a note's session describing the six basic types of chemical reaction and how to recognize them. This will be followed by an assignment where students will have to identify the type of reaction a number of balanced chemical equations are. The assignment will be reviewed in the next class meeting.

Week 2: After reviewing the type of reaction assignment, Students will then perform a lab experiment designed to prove the law is the Law of Conservation. (This experiment will take approximately two class periods to complete). A lab report outline will be distributed, and students will be assigned to write a formal lab report after completing the experiment using the format in the outline.
Week 3: The focus of week three will be on balancing chemical equations. The concept of this is satisfying the Law of Conservation A lecture will be given (accompanied by a notes outline) that discusses the Law of Conservation in chemical reactions and demonstrates a variety of strategies for balancing chemical equations. The outline also includes a variety of chemical equations that employ different strategies to complete the balancing of atoms in reactants and products. A practice sheet will be distributed for students to work on balancing a variety of equations in class with the teacher circulating and assisting students as they work on the equations. An assignment of equations to balance will be given and reviewed in the next class. Following the review of the balancing equations assignment, a formative quiz on balancing equations and identifying types of reactions will be given, corrected, and returned in class, and reviewed. As needed, remedial discussion and review on this topic will take place. Students will then perform a lab experiment where they predict the products of reactions between solutions of different metallic salts. They will also have to write balanced equations of the reactions that take place. A discussion of the concept of solubility of chemicals in water will precede this lab.
Week 4: Week four will engage the students in the study of molecular geometry. Working in groups of two or three students, students will construct 2 or 3 dimensional models of ten different models of geometric shapes of molecules using cardstock paper, glue, and scotch tape. For this activity, students will be supplied with cardstock, tape, and glue. They will also be provided with templates to make three- and four-sided pyramids as needed for several models. The students will be using line drawings of the 16 geometric models (10 for college prep chemistry) as a guide in constructing the models. This includes the shapes, general formulas, and bond angles. This project will require two full class periods to complete all models. As students work on the projects, the teacher will circulate to answer questions and make suggestions for construction of the models. Students will be responsible for identifying the geometric shapes, the generic formula (central atom, peripheral atoms attached to the central atom, unshared pairs of electrons and bond angles. Following completion of the paper models, students will compare their models to ball and stick models and make any modifications as needed to their models. A display of a set of previously prepared paper models and ball and stick matched up models will be prepared for students to photograph and use for study.
Week 5: One period of week five will be spent reviewing all of the 16 models and allowing students to photograph each of their models next to the corresponding ball and stick models for the purpose of study for a summative assessment on molecular geometry. Review will also take place during this period. The summative assessment on molecular geometry will be an oral exam given to each pair or group of three students where they will be asked 10 to 16 (10 for College Prep) questions posed to members of the group in a rotating sequence. During the assessment, students will be using their constructed models and the ball and stick models

to answer specific questions.
Week 6: A two class period comprehensive review packet of all content in the unit, based on a test outline that excludes molecular geometry, will be distributed to students. Over two class periods, a review of the packet will take place allowing students to ask clarifying questions and work on sample problems like questions that will appear on the unit test. The last period of the week is the scheduled day for the unit test to be given.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

- Students will be applying math skills (critical thinking) in problem solving and use communication skills taught in other subject areas, such as ELA.

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, Students in Honors Chemistry will be expected to construct and identify many more molecular geometric shapes than College Prep Chemistry students.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Name____ Date__________ Period_________ Chemistry

Chemical Reactions Formative Quiz **Total Point Value = 39 points**

1. Identify the type of reaction each of the following reactions (4 points each)
   a. $2C_2H_4 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

   b. $Fe(NO_3)_3 + AlCl_3 \rightarrow Al(NO_3)_3 + FeCl_3$

   c. $H_2 + Cl_2 \rightarrow 2HCl$

   c. $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$

d. $MgBr_2$ + Cl_2 → $MgCl_2$ + Br_2

e. $2H_3PO_4$ → $3\ H_2$ + $2\ P$ + $4\ O_2$

2. Balance the following chemical reactions (5 points each)

a. Cs + N_2 → Cs_3N

b. K + B_2O_3 → K_2O + B

c. Rb + $RbNO_3$ → Rb_2O + N_2

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Molecular Geometry Test

Oral/Practical Test

Names of students in the group

____

____

____

Directions: Students will be given two tries to answer a question with no penalty for an incorrect first response.

When asked to refer to a constructed or ball and stick model, students may not receive assistance from group members or the teacher in choosing the model.

The following 12 or 16 questions will be asked: (12 for CP Chemistry and 16 for Honors Chemistry)

1. Using models, the group constructed, identify a linear molecule.
2. Using models the group constructed, identify a tetrahedral molecule.
3. What is the generic formula of a trigonal planar molecule? You may refer to your constructed models or ball and stick models.
4. Using the ball and stick models, identify a trigonal bipyramidal molecule.
5. What is the generic formula of a trigonal bipyramid?
6. Using the ball and stick models, identify the octahedral molecule.
7. Match the group's constructed square planar molecule with the corresponding ball and stick model.
8. What is the generic formula of the square planar molecule? You may refer to the ball and stick models.
9. How many unshared pairs of electrons are found in a 3 dimensional bent or angular molecule?
10. What is the generic formula for an octahedral molecule. You may refer to your constructed models of the ball and stick models.
11. Using your constructed molecules, identify the trigonal pyramid.
12. What the bond angles in a trigonal planar molecule. You may refer to your constructed models.
13. Point out all the bond angles in a trigonal bipyramidal molecule. You may refer to a ball and stick model.
14. What is the generic formula for a square pyramidal molecule? You may refer to your constructed. model.
15. What are the bond angles in a tetrahedral molecule? You may refer to your constructed model.
16. What is the generic formula for a T-shaped molecule? You may refer to your constructed model.

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 3: Mole Concept and Stoichiometry
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:

Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction,

reaction force, energy).

6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

8. Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection.

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-7

Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze or accurately interpret information.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Speaking and Listening: Students will be able to present solved chemistry problems with clarity and confidence. Their presentation must include all needed formulas, show all steps in the calculations, with accurate descriptions and be able to answer questions from the class audience.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards

Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must understand and apply the basic definitions of a mole and apply these definitions to solve a variety of mole calculations such as moles to grams, grams to moles, moles to particles, particles to moles. (Particles refer to atoms of molecules) Volume of a gas at STP to moles, moles to the volume of a gas at STP, (STP refers to Standard Pressure and Temperature - one atmosphere of pressure and 0’ Celsius).	1. The concept of a mole revolves around a definition of a mole that asserts that a mole equals 6.02 X 10^{23} atoms or molecules, 6.02 X 10^{23} atoms or molecules has mass equal to its atomic weight or molecular weight expressed in grams and 6.02 X 10^{23} atoms or molecules of a gas will occupy 22.4 liters of volume at 1.00 atmospheres of pressure and 0’ Celsius. (Standard Pressure and Temperature - abbreviated as STP) (6.02 X 10^{23} is also known as Avogadro’ Number).
2. Students must be able to calculate the molar mass of a molecule using a Periodic Table as a reference.	2. Molar mass consists of the sum of the atomic weights of all atoms expressed in grams. The molar mass of a compound contains 6.02 X 10^{23} molecules.

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3. Calculation of the amount of product produced in a chemical reaction from a specified amount of a reactant or calculating the number of reactants required to produce a specified amount of a product.

4. When given equal or differing amounts of two different reactants in a balanced chemical equation, students must be able to determine which of these reactants will limit the number of products to the smallest amount when completely reacted. This is known as the limiting reactant. Additionally, students must be able to calculate the leftover amount of the non-limiting reactant. This reactant is known as the in excess reactant.
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3. Students must recognize and understand that the coefficients in balanced chemical equations represent the ratio of moles of the reactants and products. These proportional coefficients are used in calculations, known as stoichiometry, of reactants needed or products produced during the chemical reaction. There are four <u>basic</u> dimensional analysis/factor label calculations using the coefficients of a balanced reaction.
a. given number of moles to calculate an unknown number of moles.
b. given number of moles to calculate an unknown number of grams.
c. given number of grams to calculate an unknown number of moles.
d. given number of grams to calculate an unknown number of grams.

4. Students must understand and be able to apply the correct stoichiometric calculations to determine the limiting and in excess reactants and calculate the remaining amount of the in excess reactant. The limiting reactant will produce the smallest amount of products. When the limiting reactant is completely consumed, the reaction will stop, leaving an amount of the in excess reactant left over. The amount of the in excess reactant left over can be calculated with a stoichiometric calculation using the amount limiting reactant as a given and the amount of in excess reactant as the unknown. The amount of in excess calculated, is the amount that is consumed during the reaction, this is then subtracted from the initial amount when the reaction started to determine how much is left
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	over.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. Why is the mole an important measurement in chemistry? Is it based only on Avogadro's number?	1. The concept of the mole applies not only to particles of matter (atoms and molecules, but also applies to the mass of atoms and molecules. The mole concept also applies to volumes of a gaseous matter at specified conditions of pressure and temperature (STP).
2. What is the relationship between a mole of a substance and its mass?	2. The molar mass of an element or a compound is the mass of 6.02×10^{23} atoms of an element or molecules of a compound.
3. How is the mole concept related to a balanced equation?	3. The coefficients next to each reactant and product of a balanced chemical equation represent the ratio of moles of all the reactants and products in the balanced equation.
4. How is the mole concept used in calculations involving balanced chemical reactions?	4. Calculations related to balanced chemical equations employ the ratio of the coefficients of the reactants and products. These ratios are the mole ratio of all the reactants and products of the chemical reaction. Using these ratios, calculations of products formed or reactants required in a chemical reaction can be performed. These types of calculations are referred to as stoichiometry. The calculations can involve masses, moles, or volumes of a gas. All these calculations are based on the mole ratio of the balanced equation.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Informational Texts and/or Media: • *Chemistry: Principles and Reactions* by Hurley and Masterson • *Modern Chemistry* by Raymond E. Davis • *Problem Solving for Chemistry* Edward I. Peters **Online Resources / Websites:** • **Stoichiometry Direct Instruction Notes:**   ○ https://www.franklinboe.org/cms/lib/NJ01000817/Centricity/Domain/2395/Stoichiometry%20PPT.pptx

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Avogadro's Number** = the number of atoms or molecules in one mole = 6.02 X $10^{23.}$
2. **mole** - a unit of measurement for particles such as atoms or molecules (see Avogadro's number).
3. **molar mass** - the mass of the atomic weight of an element or molecular weight of a molecule expressed in grams.
4. **STP** - standard pressure and temperature. An internationally agreed set of measurements related gasses (1 atmosphere pressure and 0' Celsius).
5. **22.4 liters** - The volume of one mole of a gas measured at STP.
6. **Stoichiometry** - the proportional relationship between quantities of reactants and products in a balanced chemical reaction, typically a ratio of whole numbers. This ratio allows calculations of quantities of reactants needed and products produced in a chemical reaction.
7. **limiting reactant** - the reactant that is consumed first in a chemical reaction and therefore limits how much product can be formed.
8. **excess reactant** - the quantity of a reactant that remains after the limiting reactant has been completely consumed in a chemical reaction.
9. **percentage yield** - percent yield = the actual yield divided by the theoretical yield multiplied by 100 (to convert to a percentage). The theoretical yield is the maximum amount of product a chemical reaction could produce.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: This week will begin with a two-part lab. In the first part, students estimate the length of a molecule of stearic acid. In the second part, students will experimentally estimate Avogadro's number using stearic acid, and in a separate procedure, using aluminum foil. This lab will consume approximately 2 class periods. Students will be given class time to perform calculations in both parts of the lab with the teacher circulating around class to answer questions and assist students who may be having difficulty with the calculations. In the next class, the review of lab results and discussion will lead into an introduction of the concept of a mole as 6.02×10^{23} atoms or molecules, , molar mass and molar volume of a gas at STP. Students will be given an assignment of practice problems calculating molar masses, calculating moles given mass, calculating moles given several atoms or molecules, calculating moles given a volume of gas at STP. Students will also be informed that a formative quiz will be given after the homework is reviewed in the following week
Week 2: A review of the mole assignment will take place and student questions about the assignment will be addressed. Following this review, a formative quiz on calculating molar mass, and moles will be given. As time allows, the quiz will be graded during class, grades recorded and returned to students to review. After questions about the quiz are addressed, a PowerPoint will be used to introduce stoichiometry. Students will be given notes outline to accompany the PowerPoint. The class will conclude with the distribution of an assignment including problems using all of four basic patterns of stoichiometric calculations. Students will be told a formative quiz on the four basic types of stoichiometric problems will be given after a review of the stoichiometry assignment. The quizzes will be graded and returned to students for review in the next class period. Students will be assigned to read through an experiment procedure for a lab to be performed in the following week.
Week 3: Following this review, a demonstration of the safe use of Bunsen burners will be done and students will, using safe procedure, use burners to bend pieces of glass tubing for students to practice safe burner use. In the next class, students, working in pairs, will perform a lab to determine the formula of a hydrated chemical. This experiment involves the use of Bunsen burners to heat a hydrated salt and gather data about mass changes in the sample of the salt because the water molecules have been driven off the salt leaving anhydrous molecules of the salt. Using the ratio of the moles of driven off water to the moles of anhydrate that remains, students will be able to calculate the formula of the hydrated salt. Students will be assigned to complete all calculations and questions for the lab to be reviewed in the next class. The next class will be used to discuss and review lab results and to have the students work on practice problems using data like the lab just completed to calculate the formula of a hydrate.
Week 4: Returning to the stoichiometry PowerPoint and the previously distributed notes outline, the concept of limiting reactants will be discussed. Sample limiting reactant demonstration problems are included on the notes outline. The process to solve them will be demonstrated for the class followed by 3 practice problems for the students to solve. The practice problems will be reviewed by asking students to use the whiteboard to show how they solved them. (The chosen students will have correctly solved the problems). Following a question answer session, an assignment of limiting reactant problems will be given. In the next class, the

homework problems will be reviewed once again calling on students to the whiteboard to show their calculations. The students will be instructed to prepare for a formative quiz on limiting reactants to be given at the start of the next class. In the next class, when all students have completed the formative quiz, the problems will be reviewed for the class.
Week 5: This week will focus on calculating the amount of excess reactant left over when a reaction stopped. More practice problems about this calculation will be done and reviewed in class. Following this, the notes outline, and PowerPoint will be completed covering the topic of percentage yield of a reaction and how to calculate it followed by several practice problems for students. As the end of the week approaches, a Unit 3 summative assessment on moles, and all topics studied in stoichiometry will be announced for the following week. A comprehensive review packet will be distributed along with a test outline. In addition, a reference sheet will also be distributed for students to use in preparing for the assessment.
Week 6: The Unit 3 summative assessment will be given in the first class of the week.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Interdisciplinary Connections to Westbrook Public Schools' Portrait of a Graduate Framework

- Students will be applying math skills (critical thinking) in problem solving and use communication skills taught in other subject areas, such as ELA.

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content and more rigorous testing in their summative assessments. For example, Students in Honors Chemistry will be expected to use a more limited reference sheet for use on their unit assessment compared to College Prep Chemistry. Honors will explore at a higher-level limiting reactant problem.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Mole and Molar Mass Formative Quiz

50 Points

1 mole = 6.022×10^{23} atoms or molecules = atomic or molecular weight expressed in grams (reference information)

1. How many moles of KNO_3 are contained in 404.4 grams of this chemical?

2. How many moles of H_2O are contained in 7.65×10^{24} molecules of water?

3. How many grams of $CaSO_4$ are contained in 98.0 moles of this chemical?

4. Calculate the number of grams that are contained in 3.96×10^{22} molecules of O_2?

5. Calculate the molar mass of the following compounds:

a. BaOH

b. $MgSO_4$-7 H_2O

c. $Ca(NO_{3-})_2$

d. $C_6H_{12}O_6$

e. $(NH_4)_2SO_4$

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Moles and Stoichiometry

140 Total Points

1.How many moles of KNO_3 are contained in 404.4 grams of this chemical.

2. How many moles of H_2O are contained in 7.65×10^{24} molecules of water?

3. How many grams of $CaSO_4$ are contained in 98.0 moles of this chemical?

4. Calculate the number of grams that are contained in 3.96×10^{22} molecules of O_2?

5. Calculate the number of NH_3 molecules contained in 180 grams of the NH_3 .

6. How many grams of Na_2SO_4 are contained in 7.76 moles of $NaSO_4$?

7. How many moles of $N\text{-}_{2\text{-}}$ gas are contained in 128 liters of this gas at STP?

8. How many liters in volume will 5.29×10^{27} atoms of Helium gas occupy if the gas is at STP?

The balanced equation below applies to problems 9, 10, 11, and 12

$$C_8H\text{-}_{18} \quad + \quad 25\ O_2 \quad \rightarrow \quad 16\ CO_2 + \quad 18\ H_2O$$

9. How many moles of H_2O will be produced when 9.00 moles of C_8H_{18} are completely burned in this reaction.

10. How many grams of O_2 are needed to produce 28.0 moles CO_2?

11. If 290 grams of C_8H_{18} are completely burned in the reaction above, how many grams of O_2 will be needed in this reaction?

12. If 548 grams of O_2 are consumed in this reaction, how many moles of CO_2 will be produced?

13. Huge quantities of SO_2 are produced from ZnS in the reaction below.

$$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$$

If the typical yield is 86.78%, how much SO_2 should be expected if 4897g of ZnS are used?

14. Cl_2O is sometimes used as a powerful chlorinating agent in research. It can be produced by reacting Cl_2 with heated HgO according to the following balanced equation:

$$HgO + Cl_2 \rightarrow HgCl_2 + Cl_2O$$

What is the percent yield, if the quantity of the reactants is sufficient to produce 0.86g of Cl_2O but only 0.71 g is obtained?

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 4: Chemical Nomenclature
Pacing	2 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:

Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction,

reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of

technology’s capacity to link to other information and to display information flexibly and dynamically.

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection.

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-2.

Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to determine what type of compound they are naming. 2. Given a chemical formula, students must be able to name the compound.	1. Most ionic compounds are composed of a positive metal ion and a negative nonmetal ion. Ionic compounds may also contain polyatomic ions in their formula. Molecular compounds are composed of nonmetals and are covalently bonded molecules. Hydrocarbons are composed of Carbon atoms. 2. The key to naming chemical formulas is being able to recognize the category of the chemical formula, use the appropriate prefixes or endings of the names of the chemical, and other information such as a Roman Numeral. They must also know and be able to apply a set of “rules” for naming each category of formulas.

3. Given the name of a chemical, students must be able to write the formula of that chemical.	3. The name of a chemical substance includes information to write the correct formula. This information includes whether metals and nonmetals are in the name, only nonmetals are in the name, Roman Numerals are in the the name, and the prefixes and endings in the name.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How are chemicals named?	1. Students must understand how to recognize what type of chemical they are trying to name. The types of chemicals include ionic, molecular, hydrocarbon, oxyanions and acids or bases. After recognizing the type of chemical, there are different sets of rules to follow to name them, Ionic compounds containing metals that may, for multiple cations, require knowing how to use Roman Numerals or different endings in the name.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:
 	
• *Chemistry: Principles and Reactions* by Hurley and Masterson
• *Modern Chemistry* by Raymond E. Davis
• *Problem Solving for Chemistry* Edward I. Peters (a resource text for practice and formative assessments)
 	
Online Resources / Websites:
• https://www.youtube.com/watch?v=CVkqbHK7VhQ
  ○ Naming Compounds part 1 Bozeman Science
• https://www.youtube.com/watch?v=mrhE4lyqJ0A
  ○ Naming Compounds part 2 Bozeman Science

Vocabulary/Terminology
Vocabulary/Terminology with Definitions: 1. ion - an atom or group of atoms bonded together that have a positive or negative electrical charge. 2. cation - a positively charged ion. 3. anion - a negatively charged ion. 4. polyatomic ion - an ion composed of (two (or more) atoms that are bonded together.

5. molecular compound - a compound composed of two nonmetals. It is also known as a covalent compound.

6. hydrocarbon - a molecule composed of carbon and hydrogen and occasionally oxygen atoms.

7. alkanes - hydrocarbons where all atoms are bonded with single bonds.

8. alkenes - hydrocarbons where there is at least one double bond between two carbons.

9. oxyanions = negative polyatomic ions that contain one (or more) oxygen atoms.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)
Week 1: Week one begins with the class viewing two videos on naming chemicals. The videos cover the basic rules for naming chemicals. Following the videos, students will receive a handout with more detailed information regarding naming chemicals, organized into sections about naming the different types of chemicals. Each section is explained by the teacher and students will work on practice naming problems. in each class. A short formative assessment will be given at the beginning of each class covering the previous class period's work. It is anticipated that the class will cover two or three types of chemicals in each type of chemical naming.
Week 2: The same pattern of instruction will continue in the second week. It is anticipated that a comprehensive review of nomenclature will take place at the end of this week for a summative assessment scheduled for the first-class period on week three.
Week 3: A one period summative assessment will take place in the first-class period of this week.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

- ☒ Critically Problem Solving
- ☒ Effectively Communicating
- ☒ Creatively Thinking
- ☒ Persevering
- ☐ Socially Aware
- ☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry versus Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, students in Honors Chemistry will be responsible for being able to name a series of oxyanions where the anions either loss or gain oxygen atoms. This gain or loss of oxygen can impact the prefix and ending of the names. In addition, students in Honors Chemistry will also be studying naming series of hydrocarbon compounds.

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Ionic and Covalent Compounds Quiz

1) TeO_3

2) CS_2

3) $Fe(OH)_3$

4) CaO

5) P_4Se_3

Write the formula of each ionic or covalent compounds named below

6) bromine pentachloride

7) tetraphosphorus trisulfide

8) lithium acetate

9) zinc (II) phosphide

10)barium nitride

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Nomenclature Unit Test

1. Determine the chemical formula for the following compounds:

a. chromous oxide

b. barium nitrate

c. potassium oxalate

d. sodium chromate

e. phosphoric acid

f. silicon monoxide

g. ammonium acetate

h. dinitrogen pentoxide

i. aluminum carbonate

j. calcium hydroxide

2. Determine the type of compound (ionic, molecular, or acid) and the chemical name:

	Type	Chemical Name
a. $Mn(OH)_4$		
b. Na_2SO_4		
c. $FeCl_2$		
d. HNO_2		
e. S_2O_4		
f. $Ca_3(PO4)_2$		
g. CuS		
h. HCl		

i. CBr_4

j. CO_2

Multiple Choice:

_____ 1. The prefix hydro is used to:
a.indicate there is no oxygen in an acid
b. indicate an acid has hydrogen
c. identify a formula as a provider of hydroelectric power

_____ 2. Which of the following formulas is correct?
a. NaO
b. CaBr
c. $K_2Cr_2O_7$
d. $CaCN_2$

_____ 3. Which of the following is the incorrect chemical formula for the compound named?
a.acetic acid $HC_2H_3O_2$
b.calcium sulfate $CaSO_4$
c.magnesium hydroxide $Mn(OH)_2$
d. sulfurous acid H_2SO_3

4. Write the word true or false on the line:
_______________ a. Nonmetals and nonmetals combine to form ionic compounds.

_______________ b. In a molecular formula, mono- is never used on the second element in the formula.

.

________________c All ions formed by Group 2 elements have a charge of -2.

_______________ d. Groups 15, 16, and 17 anions will always end in -ide.

_______________ e. All ions formed by Group 17 elements have a -1 electrical charge

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 5: The Kinetic Molecular Theory and The Behavior of Gasses
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the tex

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS-1-3: Plan and investigate to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS-1-9: Analyze data to support the claim that the combined gas law describes the relationships among volume, pressure, and temperature for a sample of an ideal gas.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Speaking and Listening: Students will be able to present solutions of problems to a class in an organized and accurate manner. Their presentations must hold the attention of the class and the presenter should also be able to answer questions from the class.

Math: Students will be able to perform calculations employing algebra, scientific notation and the dimensional analysis method in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to describe, on an atomic or molecular level, what is meant by the Kinetic Molecular Theory.	1. The concept that atoms and molecules are in constant motion and that the average kinetic energy associated with the motion of the atoms or molecules is directly related to the temperature of these particles.
2. Students must be able to convert the Celsius temperature scale to the Kelvin temperature scale and be able to describe why it is necessary to use the Kelvin temperature scale in performing gas law calculations.	2. Adding 273 to the celsius temperature will convert it to the Kelvin scale. The reason for using the Kelvin scale in gas law calculations is that the Kelvin scale does not have negative temperatures. It has been determined that at -273 ‘C, atomic and molecular motion would stop. Negative temperatures in gas law calculations could lead to undefined values such as a “negative volume”.
3. Student must be able to describe the type of proportion	3. The pressure and volume of a gas are inversely

(direct or inverse) that exists between the properties of gasses including temperature, volume, pressure, and the amount (measured in moles)	proportional if temperature and amount remain constant. (Boyle's Law). The volume and temperature of a gas are directly proportional if the pressure and amount remain constant. (Charles' Law) The pressure of a gas is directly proportional to the temperature if the amount and volume remain constant. (Gay-Lussac's Law) The pressure and amount of a gas are directly proportional if the volume and temperature remain constant. (Ideal gas Law)
4. Students must be able to apply the appropriate gas law in solving problems involving the properties of a gas including pressure, temperature, volume, and amount.	4. Boyle's Law applies to problems involving pressure and volume. Charles Law applies to problems involving volume and temperature. Gay-Lussac's Law applies to problems involving pressure and temperature in a sealed container. The Combined Gas law applies to problems involving pressure, temperature, and volume. The Ideal Gas Law applies to problems involving pressure, temperature, volume, and the amount of gas.
5. Students must be able to calculate the pressure generated by each gas in a mixture of gasses, given the mass of each gas in the mixture and the total pressure,	5. Students must know how to convert mass of elements or compounds into moles. They must also know that the percent of moles of each gas in the total number of moles in the mixture is the same percent of the total pressure the mixture of gasses are generating.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How is the Kinetic Molecular Theory related to the properties of ideal and real gasses?	1. The Kinetic Molecular Theory states that molecules or atoms are in constant motion. Gas molecules are constantly elastically colliding with each other and the walls of a container. These collisions are elastic because

	there is no net loss of energy from the collisions. Gas particles are separated by large distances. The size of gas particles is tiny compared to the distances that separate them and the volume of the container. There are no interactive forces, such as attraction or repulsion, between the molecules or atoms of a gas. The average kinetic energy (energy of motion) of gas molecules or atoms is dependent on the temperature of the gas.
2. How does a change of phase in matter (ex. solid to liquid or liquid to solid. liquid to gas etc.) relate to the Kinetic Molecular Theory?	2. As the temperature of the molecules or atoms (particles) changes, the average kinetic energy (energy of motion) of these particles also changes. An increase in temperature will increase the average kinetic energy of particles. If the temperature increases enough, it results in the particles of a solid to move with sufficient energy to overcome the forces that hold the particles in place in the solid and become a liquid, where the particles can move freely, but remain in contact with other particles as they move. If the temperature continues to increase sufficiently, the particles could escape any forces of attraction between the particles in the liquid phase. The particles would then become gasses, where the particles are separated completely and moving with increased average kinetic energy and elastically colliding with each other and the walls of the container as they move. The opposite sequence of change in phase would occur, such as a gas condensing to a liquid or a liquid freezing to a solid, if the temperature is decreased. This causes the average kinetic energy of the particles to decrease. This decrease in average kinetic energy of the particles is not sufficient to continue overcoming the attractive forces between the particles.

3. What information does a phase diagram or graph provide for a change in the state of a substance?	3. A phase diagram or graph provides information such as the melting temperature of a solid or the freezing temperature of a liquid. It also shows the temperature changes that occur in the melting and freezing processes/
4. How do pressure, temperature and the volume of gasses mathematically relate with each other?	4. The relationship of the pairs of these factors can be explained in three basic gas laws. Boyle's Law states that pressure and volume of a gas are inversely proportional if the temperature of the gas remains constant. Charles Law states that the volume of a gas is directly proportional to temperature if the pressure remains constant. Gay-Lussac's Law states that the pressure of a gas is directly proportional to the temperature if the volume of the gas remains constant. These proportional relationships can be combined into one mathematical expression known as the Combined Gas Law.
5. Is there a gas law that incorporates the amount of gas, measured in moles, with pressure, temperature, and volume?	5. The Ideal Gas Law is a mathematical expression that incorporates pressure, temperature, volume, and amount of gas and allows calculation of one of these four factors if the other three factors are known. There is a constant, identified as *R* (the ideal gas constant), that is also incorporated into this law. There are multiple values for *R* dependent on the units used to measure volume and pressure. The temperature for all gas laws is measured in the Kelvin scale and amount is always in moles.
6. How is the Kelvin scale temperature determined and why is it used in the gas law calculations?	6. The Kelvin temperature is calculated by adding 273 to the Celsius temperature. The Kelvin scale does not have any negative numbers. The gas laws are based on the Kinetic Molecular Theory. It has been determined that

	all atomic or molecular motion would cease at -273' Celsius. The use of negative temperatures in gas law calculations can produce mathematically undefined results such as negative volumes. The use of the Kelvin scale eliminates this issue. In the Kelvin scale, 0' Kelvin, which equals -273' Celsius, is referred to as "Absolute Zero" where all atomic and molecular motion stops.
7. How is the pressure generated by each gas in a mixture of different gasses in a closed container determined?	7. The partial pressure of each of the gasses in a closed container is in the same proportion as the percent of total moles of each gas in the mixture of gasses.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. 1.5 Computational Thinker Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters (a resource text for practice and formative assessments)

Online Resources / Websites:

- https://orise.orau.gov/index.html
    - Source of Gas Laws/Kinetic Molecular Theory Activities

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Amorphous solid -** a non-crystalline solid that does not organize the atoms and molecules in a definite networked pattern.

2. **Boiling point -** The temperature of a liquid where the atoms or molecules possess sufficient kinetic energy to overcome the forces of attraction between the particles in the liquid phase and become a gas.

3. **Condensation -** Condensation is the process through which the physical state of matter changes from the gaseous phase into the liquid phase.

4. **Dalton's law of partial pressures -** Dalton' law of Partial Pressure states that the total pressure of a mixture of gasses is equal to the sum of the partial pressures of the component gasses: It further states that the percent of the total pressure of each gas is the same aa the percent of the total moles of each gas**.**

5. **Freezing point -** The temperature where the kinetic energy of atoms or molecules of a liquid is not sufficient to maintain a liquid state and the liquid becomes a solid.

6. **Kinetic Molecular Theory -** The Kinetic Molecular theory states that atoms or molecules are in a constant state of motion. The kinetic energy of the moving atoms or molecules is related to the temperature of the atoms and molecules.

7. **Kinetic Energy -** the energy of an object in motion.

8. **Elastic Collision -** a collision in which there is no net loss in kinetic energy because of the collision. Both momentum and kinetic energy are conserved quantities in elastic collisions. Atoms and molecules of a gas engage in elastic collisions as they collide.

9. **Kinetic Energy calculation. -** Kinetic energy is calculated using the equation K. E. = ½ (mass) ($velocity^2$). This equation indicates that velocity contributes the most to kinetic energy.

10. **Melting point -** The temperature at which the kinetic energy of atoms or molecules in solids are sufficient to overcome the forces of attraction of the particles composing a solid to change into the liquid phase.

11. **Phase diagram** - a graphic representation of the temperature changes during the change of state of a substance.

12. **Pressure -** force per unit area.

13. **Sublimation -** a change of state of a solid directly to a gas, for example dry ice.

14. **Avogadro's Principle -** Avogadro's Principle states that equal volumes of a gas at the same temperature and pressure contain the same number of atoms or molecules.

15. **Boyle's Law -** Boyle's Law states that the volume of a gas is inversely proportional to the pressure.

16. **Charles' Law -** Charles' Law states that the volume of a gas is directly proportional to the temperature.

17. **Gay- Lussac's Law -** Gay-Lussac's Law states that the pressure of a gas in a sealed container is directly proportional to the temperature.

18. **The Combined Gas Law - the** Combined Gas Law incorporates the pressure, volume and temperature into one equation arranged so as to maintain the proportions as noted in Boyle's, Charles' and Gay Lussac's Laws.

19. **Ideal Gas Law -** The Ideal Gas Law, in addition to pressure, volume and temperature includes the amount of gas measured

in moles. This law includes a constant, identified as *R.* There are multiple values for *R,* dependent on which units are used for volume and pressure.

20. **Ideal Gas Constant -** a constant used in the Ideal Gas Law. It is calculated: *R* = (pressure) (volume) / (moles)('K). Moles are represented by the letter *n* and the units for volume could be either liters or milliliters. The units for pressure could be atmospheres, mmHg or kilopascals.

21. **Molar Volume at STP -** one mole of a gas at Standard Pressure (1 atmosphere) and Standard temperature (0'C or 273 'K) will occupy 22.4 liters.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: This week will start with a demonstration of a simple phenomenon where a balloon is attached to the opening of an Erlenmeyer flask. The flask is then gently heated on a hot plate. As the flask becomes warmer, the balloon will begin to inflate and increase in volume. The flask is then immersed in an ice water bath and the volume of the balloon decreases, possibly to a point where the volume of the balloon is less than when the balloon is at room temperature. This phenomenon leads to a discussion about the basic concept of the Kinetic Molecular Theory and how it relates to gasses. A second demonstration lab will also take place where data is collected by students about the gas pressure in a sealed container at three different temperatures. The data includes the gas pressure at room temperature, at 100' C, and a temperature below 0' C. The pressure is related to the kinetic energy of molecules in the sealed container. Students then graph the data and estimate the temperature at which the pressure drops to zero indicating the temperature at which atomic or molecular motion would stop. (-273'C) A discussion of the Kelvin temperature scale and why it is used in gas laws take place. As time allows in the week, students will perform an experiment to determine the melting and freezing temperatures of an unknown solid. In this experiment, a phase diagram (graph) is drawn from the melting/freezing data collected. The phase diagram is used to identify the solid based on the melting/freezing temperature determined from the phase diagram.

Week 2: If needed, time will be taken to complete the melting/freezing temperature experiment. After the melting freezing temperature lab is completed and discussed, students will perform an experiment where the goal is to derive Boyle's Law. After completion and discussion of this experiment, a quick activity about Charles law will be done by students. The three basic gas laws,

Boyles, Charles and Gay-Lussac’s will then be summarized. The proportions of pressure, temperature and volume will be emphasized as each law is discussed. Practice problems will be done for Boyles, Charles and Gay Lussac’s laws in class. A formative quiz covering these three laws will be given at the beginning of the next class period. Following the formative quiz, the combined gas law will be discussed and practice problems about it will be done in class. The last class of the week will focus on how the Ideal Gas Law and how the Ideal Gas Constant is derived for different pressure and volume units. Demonstration problems will be solved for students and work on practice problems will be assigned as homework. In the following class period, the assigned problems will be reviewed. Students will be asked to solve the problems on the whiteboard for the class, after it has been determined that the students had correct solutions.
Week 3: During this week, Dalton’s Law of Partial Pressure will be introduced. Practice problems applying this law will take place in class and a short formative quiz on the Ideal Gas Law, Dalton's Law of Partial Pressure will be announced for the first-class period of the next week.
Week 4: Following the students’ completion of the formative quiz, the problems on the quiz will be discussed and solved on the whiteboard. A discussion with students will then take place about what to include on a reference sheet for use on a summative assessment to take place in week 5. After this discussion, a “practice test” will be distributed to the class as a review assignment for a summative test on this unit. The last class of the week will be reviewing the problems on the practice test and a question/answer session will also take place.
Weeks 5 and 6: The summative unit test will take place in the first-class period of this week. The problems on the test will be reviewed in the second-class period of the week. The tests will be returned in the third-class period of the week and a question answer session about the test will take place.

Westbrook Public Schools’ Portrait of a Graduate Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, more limited reference sheets on assessments and more difficult problems on their assessments

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Ideal Gas Law and Dalton's Law of Partial Pressure Formative Quiz

1. Three gasses are mixed in a sealed container. Gas 1 generates a pressure of 750 mmHg; Gas 2 generates a pressure of 75 mmHg and gas three generates 73.2 mmHg of pressure. What is the total pressure of the gasses in the container?

2. A steel tank has a mixture of Helium and Oxygen gasses. The total pressure in the tank is 6075 mmHg at a constant temperature. If the oxygen generates a partial pressure of 1865 mmHg, what is the pressure generated by the Helium?

3. A balloon is at a constant temperature of 32'C and volume is inflated with a mixture of 92.0 grams He, 85.0 grams of N_2, and 100 grams of F_2 gasses. The total pressure in the balloon is 800 mmHg. What is the partial pressure of each of the gasses in the balloon?

4. Calculate the volume, in liters, of 12.0 moles of oxygen at a pressure of 2.50 atmospheres and a temperature of 40.0 'C

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Kinetic Molecular Theory and Gas Laws

Directions: You may use a periodic table and your reference sheet. You must show your work and label answers with correct units to receive full credit for a problem.

1. How does the Kinetic Molecular Theory explain gasses generating pressure in a container? Also, why would the amount of pressure vary under different conditions? 10 points

2. Explain why, according to the Kinetic Molecular Theory, in Boyle's Law, pressure and volume are inversely proportional. 10 points

3. Calculate the temperature, in degrees Celsius, required to maintain the pressure in a steel tank of oxygen at 7000 mmHg. The volume of the steel tank is constant, and no oxygen is added or released from the tank. 10 points

4. A weather balloon has a volume of 150 liters, a pressure of 1.10 atmospheres and a temperature of 29.0 degrees Celsius on the ground before launching. At its maximum altitude after launching, calculate the volume of the balloon if the temperature is -20.5 degrees Celsius and the pressure is .450 atmospheres. 10 points

5. A piston in a cylinder is holding a volume of gas at 2.56 liters in the cylinder with a pressure of 1140 mmHg. What will the

pressure become if the piston is pushed in to lower the volume to 1.30 liters?
10 points

6. Another unit used to measure air pressure by meteorologists is the “bar”. One bar = 750.062 mmHg. Calculate a value of *R* for the Ideal Gas Law using bars as the pressure unit, assuming volume is measured in milliliters, temperature is 273 degrees Kelvin and there is one mole of gas involved. 10 points

7. A child’s balloon has a volume of 15.0 liters at STP. calculate the volume of the balloon if the temperature of the balloon is raised to 29.0 degrees Celsius and the pressure rises to 1.50 atmospheres? 10 points

8. A metal tank is filled with 200 grams of Helium, 150 grams of Oxygen and 40.0 grams of nitrogen. (Oxygen and nitrogen are diatomic elements). If the total pressure in the tank is 3260 mmHg. Calculate the partial pressure of each gas in the tank. 10 points

9. An inflated life jacket has a volume of 27.5 liters at a temperature of 32.8 degrees Celsius. What would the volume of the life jacket become in water at 19.6 degrees Celsius? 10 points

10. Calculate the number moles of helium gas contained in a weather balloon inflated to a volume of 79.0 liters, a pressure of 750 mmHg and is at a temperature of 37 degrees Celsius.
    10 points

Bonus: 5 points

Calculate the kinetic energy of a motorcycle with a mass of 175,000 grams traveling at a speed of 110 km per hour.

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 6: Solutions
Pacing	6 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the tex

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-3. Plan and investigate to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to identify solute and solvent in a solution.	1. Students must know that a solute is a substance being dissolved to make a solution and solvent is the substance dissolving the solute.
2. Students must be able to predict precipitates that will form in a reaction of ionic solutions using the solubility rules.	2. Students must know how to apply solubility rules to predict precipitates in a reaction between two ionic sl\olutions.
3. Students must be able to calculate the molarity of a solution given the grams and formula of a solute and the final volume (in liters) of the solution.	3. Students must know how to convert grams of a solute to to moles and know that molarity is calculated by dividing moles of solute by liters of solution.
4. Students must be able to calculate the molality of a solution given the number of grams of solute and the mass of the solute in kilograms.	4. Students must know how to convert grams of solute to moles and that water has a density of 1.00 gram per milliliter. They must also know how to convert milliliters to kilograms.

5. Students must be able to determine changes in colligative properties of solutions given the formula of the solute, the grams of solute in the solution and the kilograms of solvent.	5. Students must know how to convert grams to moles, calculate the molality of a solution and how to calculate changes in the colligative property using the appropriate constant for that particular property.
6. Students must be able to calculate the molecular weight of an unknown solute using the equation for calculating changes in freezing or boiling temperature of a solution.	6. Students must know how to mathematically manipulate the equation to determine the change in the boiling or freezing temperature of a solution to solve for the molecular weight of the solute.
7. Students must be able to determine the mole fraction of a solute in a solution.	7. The student must know how to apply the equation to calculate the mole fraction of a solute in a solution.
8. Students must be able to determine the percent concentration of a solute in a solution given the number of grams of solute and grams of the solvent (or milliliters of water) as the solvent.	8. Students must know how to apply the equation for calculating the percent concentration of a solute in a solution. Students must also know that one milliliter of water has a mass of 1.00 grams.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. What are the components of a solution?	1. A solution is composed of a solvent and a solute. The solvent dissolves the solute.
2. What are the characteristics of a solution?	2. A solution is a homogenous mix of a solvent that has dissolved a solute.
3. What are four quantitative ways to describe the concentration of solutions?	3. Four quantitative ways to describe the concentration of a solution include: molarity (moles of solute per liter of

	solution), molality (the number of moles of solute per kilogram of solvent), mole fraction (the number of moles of solute divided by the total of moles of solute plus moles of solvent), and mass percent of solute (the grams of solute divided by grams of solution, multiplied by 100).
4. What are colligative properties?	4. The physical changes in a solution that result from adding solute to a solvent. The four types of colligative properties include: boiling temperature increases, freezing temperature decreases, vapor pressure increases and osmotic pressure of a solution, preventing solute from easily passing through a semipermeable membrane. Calculation of these types of changes is associated with the molality of a solution.
5. What is solubility?	5. Solubility is the number of grams of a solute that will dissolve in each amount of solvent at a specified temperature.
6. What is meant by the statement “like dissolves like”	6. “Like dissolves like” refers to solutes that are more likely to dissolve in solvents that have similar chemical properties, such as hydrocarbon solvents will be more likely to dissolve hydrocarbon solutes.

Resources

Student Technology Integration and Correspondence to ISTE Standards:

1.1 Empowered Learner
Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1.2 Digital Citizen
Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters (a resource text for practice and formative assessments)

Online Resources / Websites:

- https://www.youtube.com/watch?v=AsCLuLS-yZY (solubility rules mnemonics)

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Homogeneous mixture** - a mixture where all components of the mixture are uniformly distributed in the solution.

2. **solvent -** a chemical that dissolves other chemicals.

3. **solute -** a chemical that is dissolved in a solvent.

4. **solubility -** the amount of solute that will dissolve in a specified amount of solvent at a specified temperature.

5. **concentration -** a quantitative measurement of the amount of solute dissolved in a solvent. It measures the "strength" of the solution.

6. **molarity -** a measure of concentration described as the number of moles of solute per liter of solution.

7. **molality** = a measure of concentration described as the number of moles of solute per kilogram of solvent.

8. **mole fraction -** a measure of concentration described as the proportion of moles of solute in a solution to the total of moles of solvent plus solute.

9. **percent concentration -** a measure of concentration described as the grams of solute divided by grams of solvent and then multiplied by 100.

10. **colligative properties -** Physical properties of a solution that are impacted by the amount of solute dissolved in the solvent. These properties include a rise in boiling temperature, a drop in freezing temperature, a decrease in vapor pressure and a change in osmotic pressure (temperature also impacts osmotic pressure).

11. **Kb -** The boiling point constant to relate molality with changes in boiling temperature of a solution. The value of the constant for water as a solvent is .512 'C/molal concentration. There are different Kb values for solvents other than water.

12. **Kf -** The freezing point constant to relate molality to changes in freezing temperature of a solution. The value of this constant for water as a solvent is -1.86 'C/molal concentration. There are different Kf values for solvents other than water.

13. **precipitate -** A solid that forms because of a chemical reaction, when two solutions are mixed together. The solid that is formed is an insoluble compound in the solvent of the original solutions.

14. **net ionic equation -** A chemical equation that only shows the ions that react to form a precipitate as the reactants, and the formula of the insoluble product when two ionic solutions.

15. spectator ions - The ions that remain in solution (unreacted) after other ions have reacted to form a precipitate.

16. immiscible - Two substances that are unable to mix together, for example oil and water.

17. saturated solution - A solution that is unable to dissolve any more solute.

18. supersaturated solution - A supersaturated solution contains more dissolved solute than required for preparing a saturated solution. It can be prepared by heating a saturated solution, adding more solute, and then cooling it quickly, for example in an ice bath.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: The unit will begin with a discussion/lecture including definition of a solution, solubility, and precipitates. Following this, a video of the rules of solubility of solutes will be shown. The video summarizes a mnemonic to make it easier to remember the rules for solubility. The students will then begin an experiment where they must predict possible precipitates that will form when all possible combinations of six ionic solutions are mixed. The data collected will determine whether a precipitate form in the combinations of solutions and make observations to describe the precipitates will also be noted. Students will be assigned to confirm their predictions and write chemical equations of the combinations of solutions that produced precipitations and then a net ionic equation for each reaction. In the next class, the assignment will be reviewed to open the class period, and students will make any changes as needed in their reactions. Once this is completed, students will be instructed on how to calculate the molarity of a solution and be given several molarity practice problems to solve in class. As time allows, a demonstration of a supersaturated solution will be done. Students are assigned to prepare for a formative quiz on molarity in the next class. The last class of the week will consist of the formative quiz, followed by demonstration problems on how to calculate the molality of a solution. Students will be assigned molality problems due at the beginning of the next class.

Week 2: The molarity quizzes will be returned and reviewed, giving students time to ask questions and correct the problems. Following this, the molality assignment problems will be reviewed by having students show and discuss their solution to the problems on the whiteboard. A lecture discussion will then take place, employing a notes outline, on colligative properties.

Specifically, the relationship of molality and how this affects boiling and freezing temperature of water will be discussed. The notes will focus on an equation used to calculate the change in boiling and freezing temperatures of water. Boiling and freezing point constants of water are discussed as an integral part of the equation as well as the importance of the number of particles (ions or molecules) in the calculation. Sample problems of calculating freezing and boiling temperatures of water solutions will be demonstrated by the teacher and will be included in the notes outline. Students will be assigned practice problems involving molality and colligative properties due in the next class.
Week 3: Assigned problems will be reviewed in class to begin the week. Sample problems will be done as demonstrations of how to calculate the molecular weight of an unknown solute in a water solution. (Honors Chemistry only). Students will be given two practice problems to be done and reviewed in class. A formative quiz covering molality, and colligative properties will be assigned for the next class period.
Week 4: The formative quiz on molality and colligative properties will be given in the first-class period next week. After all students are finished with the quiz, the problems on the quiz will be reviewed. The remainder of the class will focus on how to calculate mole fraction and percent concentration including practice problems to be done in class. The rest of this week will focus on a comprehensive review of solutions in preparation for a unit summative assessment next week. The review will include a drafting of a reference sheet for use on a unit test, and practice problems based on a test outline. Students will work in small groups on these practice problems while the teacher circulates around to the groups to answer any questions. The unit six assessment will take place in the first class of next week.
Week 5: The Unit six summative assessment will be given on the first day of Week 5.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering

☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for average ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, calculating the molecular weight of an unknown solute using change in freezing/boiling temperature (molality based and colligative properties)

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Molarity Assessment

1. Calculate the molarity of a solution when 6.53 moles of KBr are dissolved in water to make 2.10 liters of solution. **10 points**

2. Calculate the molarity of a solution when 18.4 grams of $KMnO_4$ are dissolved in water to make 1.90 liters of solution. **10 points**

3. How many moles of $NaNO_3$ should be dissolved in water to make 4.89 liters of solution with a molarity of 3.25 moles/liter. **10 points**

4. Determine the final volume of a solution prepared by dissolving 60.5 grams of $MgCl_2$ in water to make a final concentration of 2.75 M. **12 points**

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Unit 6 Solutions Assessment

1. What is the molarity of a solution that contains 10.0 grams of $AgNO_3$ that has been dissolved in water to make 750 milliliters of solution? **12 points**

2. You want to create a 0.25 M KCl solution. You weigh 5.00 grams of KCl . What will the final volume of the solution be? **12 points**

3. What is the molality of a solution that contains 48 grams of NaCl dissolved in 250 milliliters of water? **12 points**

4. What is the percentage by mass of the solute from problem 1? **12 points**

5. How many milliliters of hydrogen peroxide (H_2O_2) and water are needed to make a 8.5% solution by volume of hydrogen peroxide if you want to make 450 mL of solution? **12 points**

6. What is the mole fraction of the solute in the solution from problem 1? **12 points**

7. What is the mole fraction of the solvent in the solution from problem 1? **12 points**

8.What is the molality of a solution that contains 13.4 grams of $CaCl_2$ dissolved in 655 milliliters of water?
12 points

9. A. Determine the freezing temperature of a solution prepared by dissolving 100 grams of $Ca(NO_3)_2$ in 250 milliliters of water.
6 points

B. Determine the boiling temperature of the solution prepared in part A above. **6 points**

10. Determine the molecular weight of an unknown solute when 39.3 grams of the unknown are dissolved in 250 milliliters of water. **12 points**

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 7: Acids and Bases
Pacing	4 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a

problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-2
Matter and its Interactions: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4
Matter and its Interactions: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS1-5
Matter and its Interactions: Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, considering possible unanticipated effects.

HS-PS1-6 Matter and its Interactions: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium**.** **HS-PS1-7** Matter and its Interactions: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system. Students must be familiar with the basic definition, and how to calculate on a scientific calculator, logarithms.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to identify acids and bases by their chemical formulas.	1. According to the Arrhenius acid base theory, nonorganic acid formulas begin with a hydrogen and base formulas end with a hydroxide ion (OH^{-1}), for example HNO_3

	nitric acid and NaOH sodium hydroxide.
2. Predict the products of an acid base chemical reaction.	2. Acid base reactions are a specialized double displacement reaction. The products of an Arrhenius acid base reaction are salt and water. A salt is defined as a metal-nonmetal compound, for example NaCl or CaI_2.
3. Students must be able to identify a solution is acidic, basic, or neutral using the pH scale.	3. On the pH scale, a pH below 7 indicates an acidic solution and above 7 indicates a basic solution. A pH of 7 indicates a neutral solution (not acidic or basic). The pH scale goes from 0 to 14.
4. Students must be able to calculate the pH of a solution, given the concentration of an acid.	4. Students know that calculation of pH is based on logarithms, using the equation pH = - (log $[H^+]$). The [] symbols mean concentration in moles/liter. Students must be proficient in using a calculator to work with numbers in exponential expression and determine the logarithm of these numbers on a calculator.
5. Students must be able to calculate the pOH of a solution.	5. Students must know pOH scale is like the pH scale in that a pOH of 7 is indicative of a neutral solution. A basic solution has a pOH less than 7, while an acidic solution has a pOH of greater than 7. The pOH is convenient to use when finding the hydroxide ion concentration from a solution with a known pH. pOH is calculated using the equation. pOH = - (log $[OH^{-1}]$)
6. Students must be able to determine the $[H^+]$ given the $[OH^{-1}]$. and determine the $[OH^{-1}]$ given the $[H^+]$.	6. Students must know that the water constant is calculated by the equation $KH_{2O} = [H^+] \times [OH^{-1}] = 1.00 \times 10^{-14}$. In a chemically neutral solution, $[H^{+1}]$ and $[OH^{-1}]$ are both equal to 1.00×10^{-7}. By mathematically manipulating the K_{H2O} equation, the $[H^{+1}]$ or $[OH^{-1}]$ can be determined.

7. Students must be able to identify Bronsted-Lowry acids and bases and, in a Bronsted-Lowry chemical reaction, identify the conjugate base and acid formed from the reacting acid and base.	7. Students must know that in the Bronsted–Lowry definition of acids and bases, an acid is a proton (H^+) donor, and a base is a proton acceptor. When, in a Bronsted–Lowry chemical reaction, an acid donates a proton, a conjugate base is formed as a product in the reaction. Similarly, when a Bronsted–Lowry base accepts a proton, a conjugate acid is formed as a product in the reaction.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do the concentrations of hydrogen ion and hydroxide ion determine the acidity and basicity of a solution?	1. Concentrations of H^{+1} ions and OH^{-1} ions are related logarithmically to pH and pOH. pH and pOH are logarithmic scales that measure the acidity and basicity of a solution.
2. If you know the pOH of a solution, how do you determine the pH or if the pH is given, can you determine the pOH?	2. As a result of the logarithmic relationship of pH and pOH, the pH of a solution can be determined with the following equation: pH + pOH = 14
3. Can the concentration of H^{+1} or concentration of OH^{-1} be calculated in a water solution of an acid or base?	3. The $[H^{+1}]$ and $[OH^{-1}]$ in a water solution have the following math relationship: The product when multiplying the concentrations of H^{+1} and OH^{-1} equals a constant number of 1.00×10^{-14}. The equation $K_{H2O} = [H^{+1}] \times [OH^{-1}] = 1.00 \times 10^{-14}$ can be manipulated to solve for $[H^{+1}]$ or $[OH^{-1}]$ given the concentration of the other ion.

4. Are there other definitions of acids and bases beside the Arrhenius definition? 5. What are indicators?	4. Another definition of acids and bases is known as the Bronsted-Lowry Theory which states that acids are proton donors and bases are proton acceptors. A proton is H^{+1} ion. In the Lewis Acid/Base theory, a Lewis base donates a pair of electrons to a Lewis acid which accepts the electrons from the base. 5. Indicators are weak acids or bases that ionize in water solutions and change color in a solution when the pH of the solution changes. Different indicators will change colors in different ranges of pH.

Resources

Student Technology Integration and Correspondence to ISTE Standards:

1.1 Empowered Learner
Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1.2 Digital Citizen
Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological

methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* Edward I. Peters

Online Resources / Websites:
- A3Academy: Lewis Acids and Bases
- Brønsted-Lowry Conjugate Acid-Base Pairs

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **Arrhenius acid -** a chemical that releases H^{+1} ions when dissolved in water.
2. **Arrhenius base -** a chemical that releases OH^{-1} ions when dissolved in water.
3. **Bronsted-Lowry acid -** a chemical that donates protons to a Bronsted-Lowry base.
4. **Bronsted-Lowry base -** a chemical that accepts donated protons from a Bronsted-Lowry acid.
5. **conjugate acid -** the product when a Bronsted-Lowry base gains a proton.
6. **conjugate base -** the product when a Bronsted-Lowry acid donates a proton.
7. **H_3O^{+1} -** a hydronium ion (same as a H^{+1}).
8. **acidic solution -** a solution where there are more H^{+1} ions than OH^{-1} ions.

9. **basic solution -** a solution where there are more OH^{-1} ions than H^{+1} ions.

10. **pH -** the negative log of the $[H^{+1}]$. A scale from1 to 14 that shows the acidity or basicity of a solution. 1 to 7 is acidic and 7 to 14 is basic. pH of 7 is neither acidic nor basic, it is neutral.

11. **pOH -** the negative log of the $[OH^{-1}]$. A scale from 1 to 7 that shows the basicity or acidity of a solution. 1 to 7 is basic and 7 to 14 is acidic. A pOH of 7 is neither acidic nor basic, it is neutral.

12. **amphoteric -** a substance that act as either an acid or a base, such as water.

13. **strong acid or base -** an acid or base that completely ionizes in a solution.

14. **weak acid or base -** an acid or base that ionizes only a small amount in a solution.

15. **titration -** a titration is an experimental procedure where a solution of known concentration is used to determine the concentration of an unknown solution.

16. **titrant -** the solution of known concentration used in a titration.

17. **analyte -** the solution of unknown concentration in a titration.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)
Week 1: The unit on acids and bases will begin with a phenomenon where the teacher exhales (through a straw) into water that contains a solution of phenol red indicator. As the teacher exhales, the solution's color changes from red to orange and eventually bright yellow. The class is asked for possible explanations of this observed change. Following discussion, the teacher writes a chemical equation on the whiteboard that shows that the carbon dioxide in the exhaled breath combines with water to form carbonic acid. It is explained that as the concentration of acid increases it causes the sequence of color changes. Following this demonstration, introductory notes on the Arrhenius Theory of acids and bases will be given. This then leads to discussion of pH as a

scale to measure the acidity and basicity of solutions. After a quick review of logarithms, students are instructed in the use of calculators to determine pH using the equation pH = -(log $[H^{+1}]$). Practice problems are assigned to work on in class and reviewed. Students are assigned to prepare for a formative assessment in the next class. Following the formative assessment on the Arrhenius Acid Base Theory and pH, the concept of pOH is introduced, compared to pH, and calculations of pOH are demonstrated by the teacher and practice problems are done in class and reviewed.
Week 2: The concept of the water constant, K_{H2O}, is explained and how it is used to calculate concentrations of $[H^{+1}]$ or $[OH^{-1}]$ in a water solution. Several practice problems will be demonstrated on the whiteboard and how the resulting answers can be used to calculate pH or pOH. Students will be assigned similar problems for homework due in the next class. Students will begin this assignment in class with the teacher circulating to answer questions, assist with use of calculators, and check answers as students' complete problems. The assigned problems will be reviewed in the next class by having students show their solutions to problems on the whiteboard. Following the review of the homework problems, a two problem "open note" formative quiz will take place. As time allows in class, the Bronsted-Lowry theory of acids and bases will be introduced. The introduction of this will include definitions of Bronsted-Lowry acids and bases and how to recognize them in a chemical reaction, A video will then be played defining conjugate acid base pairs in Bronsted-Lowry acid base reactions using molecular models to illustrate this concept. Students will then be assigned practice problems for homework where they must identify conjugate acid base pairs in chemical reactions. The teacher will again circulate in class answering questions and checking answers to problems. Problems are due in the next class.
Week 3: The week begins with a review of the assigned problems by having students go to the whiteboard and explain how they identified the conjugate acid base pairs in an equation. Following this, the class will view a video that defines the Lewis acid base theory and illustrates examples using molecular models of this type of chemical reaction. Students will then be given several practice examples of Lewis acid base reactions to complete in class and then reviewed in class. A summative assessment is announced for the last class in the following week and a test outline will be distributed.
Week 4: Students will perform a titration experiment where the goal is to gather data to use in calculations to determine the concentration of a solution of hydrochloric acid. After the calculations are reviewed and handed in, a comprehensive review of the unit will take place in preparation for the unit summative assessment which will take place in either the last class of the week or the first class of Week 5.

Westbrook Public Schools' Portrait of a Graduate
Learning Expectations

The Westbrook Student will meet expectations by…

☒ Critically Problem Solving
☒ Effectively Communicating
☒ Creatively Thinking
☒ Persevering
☐ Socially Aware
☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support

Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.

Enrichment: Students who need to be challenged more will become responsible for higher level subject content. Honors Chemistry will be assigned more advanced problems as practice and assessment problems such as identifying Lewis Acids and Bases in an equation and drawing a molecular model of the (analyte) product that is produced in the reaction.

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Arrhenius Theory and pH Formative Quiz

1. Define or explain the Arrhenius Theory of Acids and Bases 10 points

2. Calculate the pH of a solution where $[H^{+1}] = 5.68 \times 10^{-10}$ M. Is this solution acidic or basic? 10 points

3. Calculate the pH of a solution where the $[H^{+1}] = 2.31 \times 10^{-4}$ M. Is this solution acidic or basic 10 points

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Unit 7 Summative Assessment

1. a. Calculate the $[H^{+1}]$ in a solution if the $[OH^{-1}]$ in the solution is 3.67×10^{-4} M 10 points

b. Calculate the $[OH^{-1}]$ in a solution if the $[H^{+1}]$ in the solution 7.89×10^{-8} 10 points

2. a. Calculate the pH of a solution where the $[H^{+1}]$ is 3.63×10^{-6}. Is the solution acidic or basic and is the solution weak or strong? 10 points

b. Calculate the pOH of a solution where the $[OH^{-1}]$ is 2.96×10^{-11}. 10 points

c. The pOH of a solution is 2.53 Calculate the pH of this solution 10 points

d. Calculate the $[H^{+}]$ in the solution described in part c above. 10 points

3. Identify the Bronsted Lowry acids and bases of the reactants in the equations below:

a. H_2O + S^{-2} → HS^{-1} + OH^{-1} 10 points

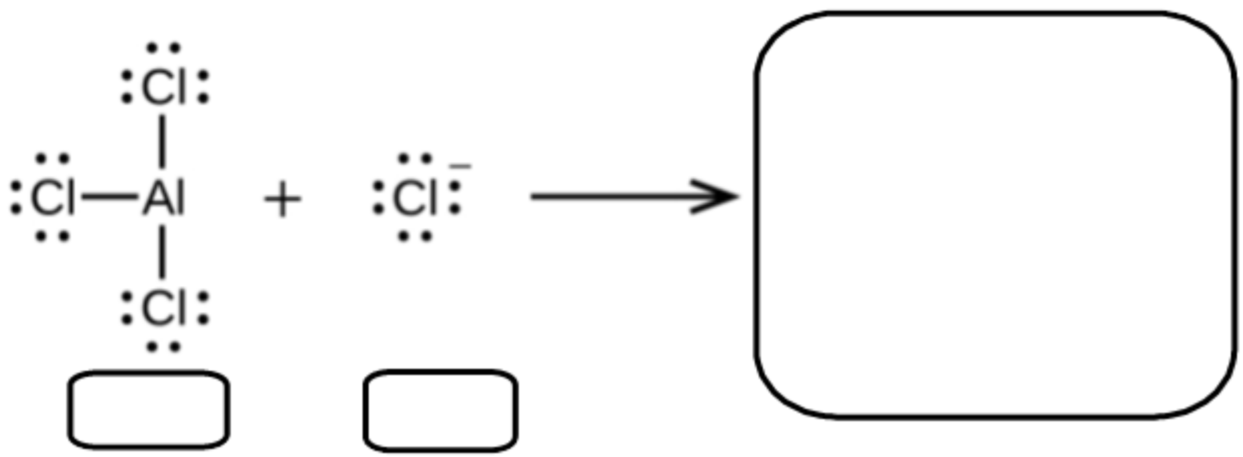
b. $CN^{-1}_{(aq)}$ + $HC_2H_3O_{2(aq)}$ ßà $C_2H_3O_2^{-1}{}_{(aq)}$ + $HCN_{(aq)}$ 10 points

c. Identify the Bronsted-Lowry acid/base conjugate pairs in the equations of parts a and b above.

(a) 10 points

(b) 10 points

4. Identify the Lewis Acid and Lewis base in the two equations that follow. Also draw the structure of the product (analyte) in each equation in the spaces provided 12 points each (total points in this problem = 24)



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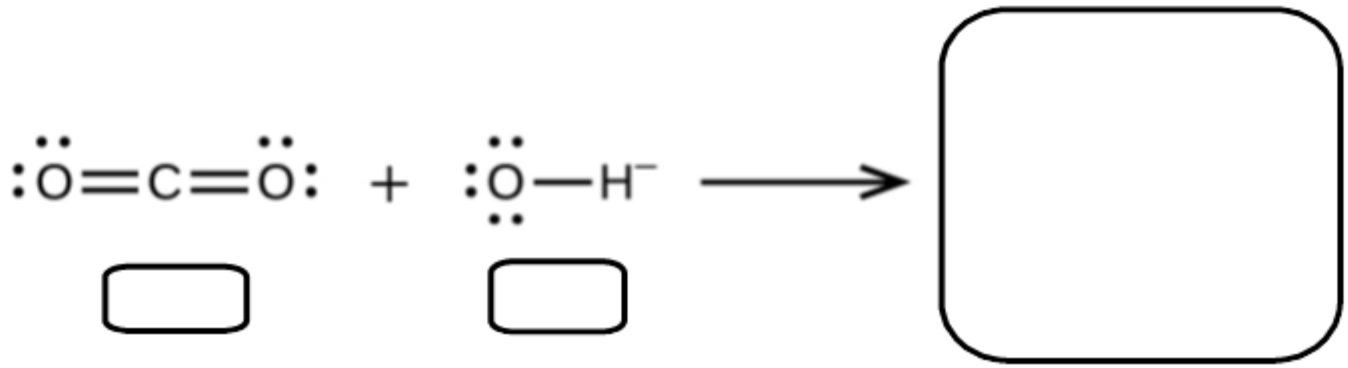

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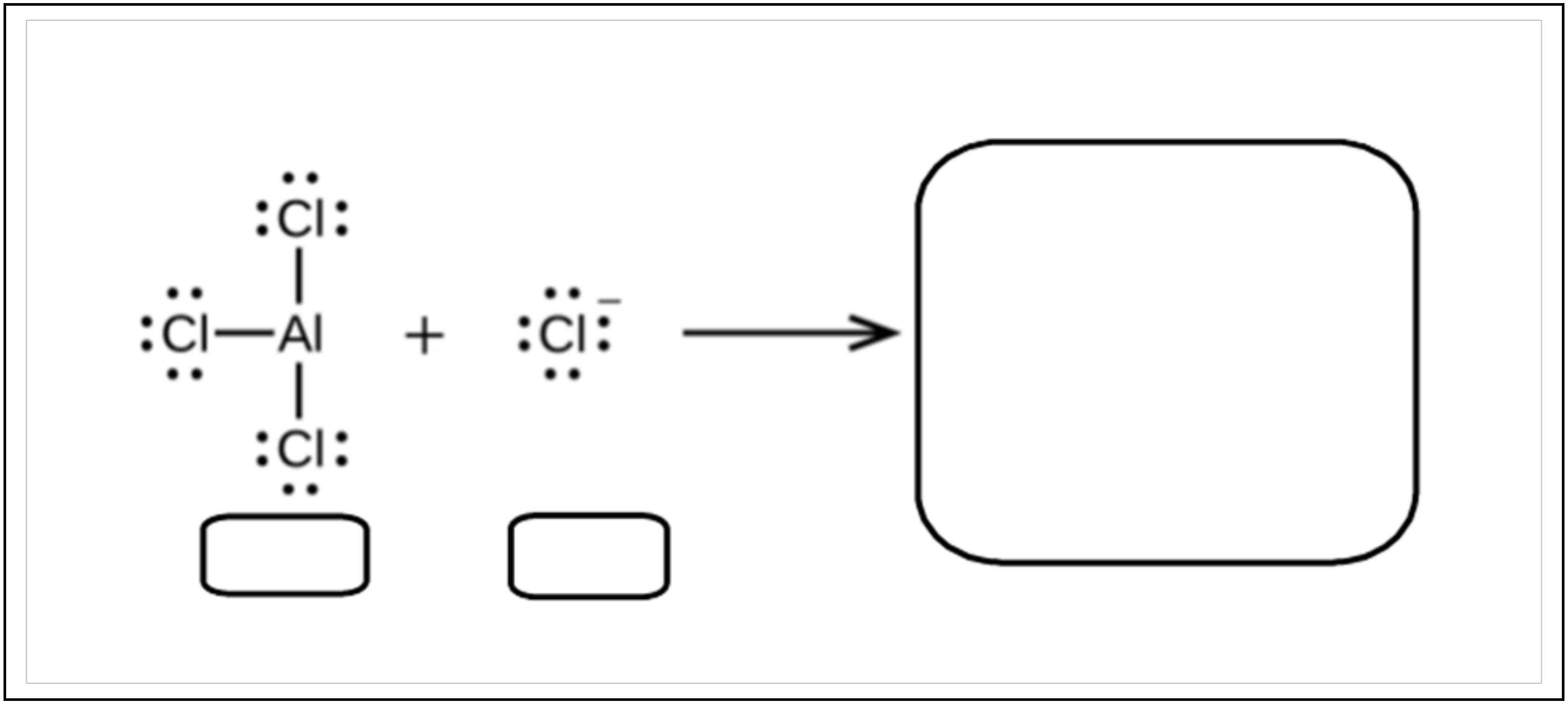


Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 8: Rate of Reactions and Chemical Equilibrium
Pacing	4 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the tex

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Correspondence to CT Core Standards

What are the goals of this unit?

Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem.

Writing: Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion.

Math: Students will be able to perform calculations employing algebra, scientific notation and dimensional analysis problems in solving problems as needed. Students will be able to convert units of measurement in the metric system. Students will also be familiar with scientific calculators and how to use the scientific calculator for calculations involving exponents.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to interpret reaction coordinate graphs to determine activation energy of uncatalyzed and catalyzed chemical reactions. They must also be able to identify a reaction as either an exothermic or endothermic reaction from the reaction coordinate graph.	1. Students must know that chemical reactions have a minimum energy requirement to begin the reaction called activation energy. A catalyst creates a reaction mechanism with multiple steps, each with lower activation energies, rather than a one-step reaction with a significantly higher activation energy. In exothermic reactions, the reaction coordinate graph will show that the products will contain less energy than the reactants. The difference in the energy between the reactants and products is the amount of energy contained in the reactants that is given off in the reaction. In an endothermic reaction, the reaction coordinate graph will show that the products contain more energy than the reactants. The difference in the energy is the amount of energy absorbed by the products in the reaction.

2. Students must be able to explain why changes in temperature of reactants or the concentration of the reactants will change the rate at which a reaction will occur.	2. Students must know that an increase in temperature of reactants causes an increase in the average kinetic energy of the reactant particles. This increase results in more collisions of the reactant particles that result in a reaction to occur. A decrease in temperature will result in a decrease in the average kinetic energy of the reactant particles which results with fewer collisions between the reactant particles Fewer collisions resulting in a slowdown of the rate of reaction. An increased concentration of the reactant particles will decrease the average distance between reactant particles therefore increasing the number of collisions between reactant particles, resulting in more reactions between the particles. A decrease in concentration of the reactant particles increases the average distance between reactant particles resulting in fewer collisions of the reactant particles therefore decreasing the number of reactions between particles.
3. Students must be able to describe what is meant by equilibrium in a chemical reaction.	3. Students must know that equilibrium in a chemical reaction means that the rate of the forward reaction (reactants→ products) is equal to the rate of the reverse reaction (products→ reactants). This assumes that the reaction is reversible. As more products are produced, the rate of the reverse reaction increases will become equal to the rate of the forward reaction. Students must also know that a reaction at equilibrium does not mean there are equal amounts or concentrations of reactants and products.
4. Students must be able to calculate an equilibrium constant for a reaction given the concentrations of the	4. Students must know that the concentration of reactants

reactants and products are at equilibrium and at a stable temperature.	and products are stable, but not necessarily equal, in a reaction at equilibrium at a stable temperature. They must also know the generic equation to calculate the equilibrium constant. Given a generic chemical reaction at equilibrium: aA + bB <=> xX + yY, the equation to calculate the equilibrium constant is $K_{eq} = [X]^x\ [Y]^y / [A]^a\ [B]^b$ The capital letters in [ ] represent the concentrations of the reactants and products at equilibrium and the lowercase letters represent exponents. These exponents outside the [] are the coefficients of the reactants and products in the balanced chemical equation
5. Students must be able to use Le Chatelier's Principle to make qualitative predictions of changes in a chemical reaction at equilibrium when changes such as concentration of a product or reactant or a change in temperature are made.	5. Students must know that Le Chatelier's Principle states that when a stress is placed on a chemical reaction at equilibrium, such as a change in the concentration of a reactant or product, or a change in temperature, processes occur that tend to counteract the changes and bring the reaction to a new equilibrium. These processes involve changes in either forward or reverse rates of reaction that will bring the reaction to a new equilibrium.
6. Students must know what IRE charts are and how they are used to determine equilibrium concentrations and K_{eq} in a chemical reaction at equilibrium.	6. IRE charts organize the Initial moles/liter, Reacting moles/liter and Equilibrium moles/liter of reactants and products. These charts use initial given information, and stoichiometric calculations to determine reacting moles/liter and equilibrium moles/liter to calculate the K_{eq} for an equilibrium reaction.
7. Students must be able to calculate the value of K_{eq} when	7. Students must know how to set up a three-level table

given a balanced, reversible, chemical equation and given information about the initial moles of each reactant that are placed in an empty one-liter container and allowed to react to reach equilibrium. Students will also be given the concentration (moles/liter) of the product(s) in the container at equilibrium.	(IRE Chart) of the given information (initial moles/liter, reacting moles/liter and equilibrium moles/liter) for each reactant and product and be able to use simple stoichiometric calculations, as needed, to determine reacting moles/liter of reactants and product. Equilibrium moles/liters of the reactants can then be calculated using subtraction of reacting concentrations from initial concentrations. Knowing all equilibrium concentrations, students will then use the equilibrium concentrations to calculate K_{eq} for the reaction.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How can the rate of a chemical reaction be controlled?	1. The rate of a chemical reaction can be controlled by numerous factors, such as temperature, concentration, pressure, particle size or catalysts.
2. What is the role of energy in chemical reactions?	2. Chemical reactions require a minimum amount of energy to start called the activation energy. Also, changes in temperature can cause changes in the average kinetic energy of atoms and molecules. If the temperature is increased, the average kinetic energy of atoms or molecules increases. Increased average kinetic energy causes collisions between particles with greater force which results in more reactions between the particles, If the temperature is lowered, the opposite results occur: Decreasing average kinetic energy, collisions of particles with less energy occur, resulting in fewer reactions between particles.

3. What is a reversible chemical reaction? 4. What does it mean to have a chemical reaction at equilibrium? 5. What are IRE charts and how are they used to determine equilibrium concentrations?	3. A reversible chemical reaction reacts in two directions at the same time. They react from reactants to products and products to reactants at the same time. 4. A reversible chemical reaction at equilibrium means that the rate of the forward reaction and the rate of the reverse reaction are equal. 5. IRE charts are three level charts that organize the Initial moles/liter, Reacting moles/liter and Equilibrium moles/liter of reactants and products. These charts use initial given information, and stoichiometric calculations to determine reacting moles/liter and equilibrium moles/liter to calculate the K_{eq} for an equilibrium reaction.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. 1.2 Digital Citizen Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. 1.3 Knowledge Constructor Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1.5 Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond by E. Davis
- *Problem Solving for Chemistry* by Edward I. Peters

Online Resources / Websites:
- link to Introduction to equilibrium

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **activation energy** - the minimum amount of energy needed to activate or energize molecules or atoms so that they can undergo a chemical reaction or transformation.

2. **activated complex -** unstable arrangement of atoms that forms momentarily at the peak of the activation energy barrier.

3. **catalyst** - a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.

4. **Reaction coordinate graph** - A reaction coordinate diagram is a graph that shows the relationship between energy and reaction progress.

5. **reversible reaction -** reaction in which the conversion of reactants to products and the conversion of products to reactants occur simultaneously.

6. **Equilibrium position -** describes the relative concentrations of reactants and products when a chemical reaction reaches equilibrium.

7. **Equilibrium -** a reversible chemical reaction in which the rate of the forward reaction is equal to the rate of the reverse reaction.

8. **Forward reaction -** in a chemical reaction at equilibrium, reactants producing products is the forward reaction.

9. **Reverse reaction - ** in a chemical reaction at equilibrium, products producing reactants is the reverse reaction.

10. K_{eq} - the ratio of the mathematical product of the concentrations of the products of a reaction to the mathematical product of the concentrations of the reactants of the equilibrium reaction. Each concentration is raised to the power of its coefficient in the balanced chemical equation. $K_{eq\ i}$ is called the equilibrium constant.

11. **IRE chart** - an acronym for a three-level chart that includes data on concentration in moles/liter of reactants and products that male it possible to calculate the K_{eq} for a chemical reaction at equilibrium.

12. **collision theory -** a brief event in which two or more atoms/molecules come together in a collision that may possibly react with each other.

13. **Le Chatelier's Principle - the** principle that states that if any change is imposed on a reaction that is in equilibrium, then the reaction tends to adjust to a new equilibrium counteracting the change.

Learning Plan *Overview and Key Learning Events and Instruction Per Week*
Learning Tasks Per Week (Including Instructional Strategies)
Week 1: After a demonstration of a phenomenon where two colorless solutions are mixed together in a flask and in approximately 30 seconds a sudden color change of the entire mixture of solutions turns from clear to blue/black occurs. Students will be asked to explain what might have happened. Following a brief discussion of student responses, the teacher will write a series of chemical

equations representing the steps in the reaction that occurred in the flask. . Students will then perform an experiment, using the same solutions, to determine the effect of changing temperatures and concentration of the solutions on the time required for the same color change to be observed. Discussion about results and conclusions about this experiment will take place in the next class. Sample reaction coordinate graphs will then be distributed to the class. The teacher will demonstrate how to analyze the energy changes in a reaction coordinate graph. Time will then be given for students to analyze the distributed sample reaction coordinate graphs and then individual students will be asked how they determined the activation energy of the reaction, whether the reaction is exo or endothermic and if the reaction will occur spontaneously or will be difficult to proceed without adding energy to reach the activation energy. The teacher will then distribute a sample of a catalyzed reaction, while defining the role of a catalyst. An analysis of the catalyzed reaction coordinate will be done by the teacher. A formative assessment on analysis of reaction coordinate graphs was announced for the next class period. and students were assigned to prepare for it.
Week 2: The reaction coordinate graph formative assessment will take place at the beginning of the first class of the week. The quiz will be graded, recorded, and returned to students while students view an introductory video on Chemical Equilibrium. The quiz questions will be then reviewed, and questions answered. Following the review of the quiz, notes will be given on equilibrium including how to calculate the value of an equilibrium constant. Demonstration problems of this calculation will be done by the teacher including, if needed, how to use exponents on a calculator. Students will then be given practice problems (and homework) to work on in class. The teacher will circulate among the students to answer questions, check answers, and show use of a calculator when using exponents if needed by some students. In the next class, assigned problems will be reviewed and a demonstration covering Le Chaelier's Principle will take place using solutions. Copies of an experiment to determine the equilibrium constant for a chemical reaction will then be distributed and procedures such as serial dilution of a solution, and how depth ratios of solutions in vials of equilibrium reactions are used to determine concentrations of products of the reaction.
Week 3: The students will begin the week performing the experiment that was distributed in the previous week. Time will be taken in the next class period to work with the groups of students (who worked together on the equilibrium experiment) to guide, as necessary, with calculations using the data they collected in the previous class. When calculations are completed, students will be given a series of questions about the lab including objectives, how the calculations lead to accomplishing the objects and the final result of the calculation of the equilibrium constant. Completed questions will be due in the next class period, discussed and reviewed. Students will be given a test outline for a Unit 8 summative assessment and a test date in week 4 was announced.
Week 4: A comprehensive review of Unit 8 will take place early in the week in preparation for the Unit 8 summative assessment.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

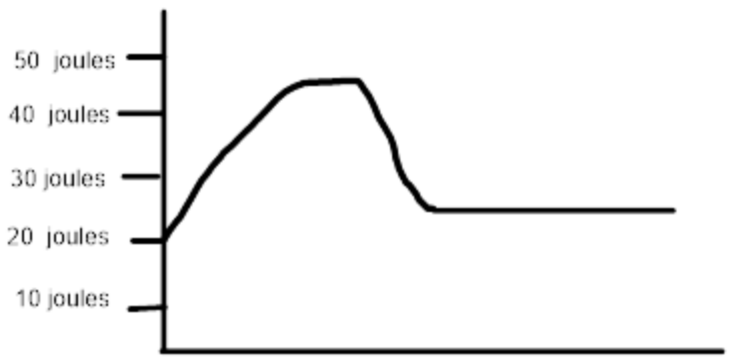
Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example the use of **IRE charts** to calculate K_{eq} using limited given information.
Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments *Include an overview of authentic assessments*
Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

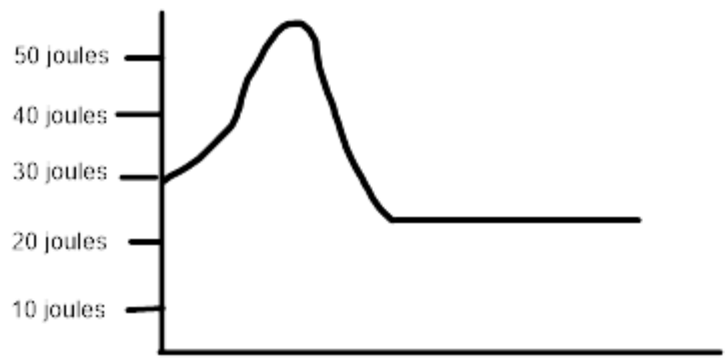
Formative assessment - reaction coordinate graphs

Analyze the following reaction coordinate graphs. Identify and calculate the activation energy and determine if the reaction is exothermic or endothermic. ten points each Total points= 20 points

1.



2



Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Unit 8 Reaction Rate and Equilibrium Summative Assessment

Directions: Answer all questions/problems that follow. You must show your math if a problem requires calculations in order to receive credit.

1. What two quantities that must be measured to establish the rate of a chemical reaction and cite several factors that affect the rate of a chemical reaction. 10 points

2. Use the atomic or molecular collision theory to explain what would happen if the following changes of conditions occurred in the chemical reaction below.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2$$

a. Increase the temperature of the reaction 10 points

b. Increasing the concentration of $C_6H_{12}O_6$ 10 points

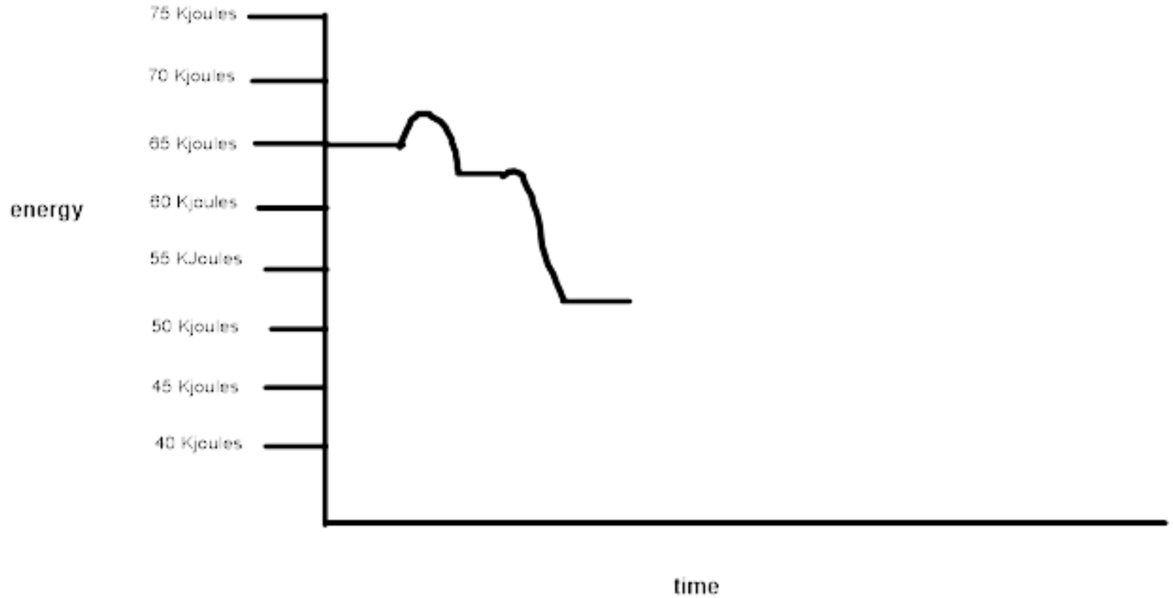
c. Decreasing the concentration of O_2 10 points

d. Decreasing the temperature of the reaction   10 points

3. Use the reaction coordinate graph below to answer the following questions.
   a. What is the value of the activation energy for this reaction? 10 points

   b. Is the reaction exothermic or endothermic? Explain your answer. 10 points

   c. Does this reaction have a catalyst involved? Explain your answer. 10



points

4.a. Given the reaction below at equilibrium.

$$2H_{2\,(g)} + O_{2\,(g)} <=> 2H_2O_{(g)}$$

At equilibrium, the concentrations of the reactant and products are: H_2 3 moles/liter. O_2 1 mole/liter and H_2O 2 moles/liter. Calculate the value of K_{eq}. 10 points

4 b. Given the reaction below at equilibrium.

$$2\ SO_{2\,(g)} + O_{2\,(g)} \Leftrightarrow 2\ SO_{3\ 9g)}$$

At equilibrium, the concentrations of the reactants and products are:

SO_2 $3.00 \text{ X } 10^{-3}$ moles/liter

O_2 $3.50 \text{ X } 10^{-3}$ moles/liter

SO_3 5.00×10^{-2} moles\/liter

Calculate the value of K_{eq} 15 points

5. a. Given a generic chemical equation at: $A + 3B \Leftrightarrow 2C$

Four moles of A and 8 Moles of B are allowed to react in a one-liter container. When the reaction reaches equilibrium 4 moles of C are present in the container. Using an IRE chart, calculate the value of K_{eq} for this reaction. 15 points.

5. b. 8.2 moles of O_2 and 8.0 moles of NO are placed in a 1 liter container and allowed to react until equilibrium is reached according to the following equation: $2\ NO + O_2 \Leftrightarrow 2\ NO_3$

When equilibrium is reached, the [NO] is 3.2 moles/liter. Using an IRE chart, calculate the value of K_{eq}. 20 points.

6. Describe the process that would happen in a reversible reaction that starts and reaches equilibrium. 10 points

Westbrook Public Schools Curriculum
Honors and College Prep Chemistry, Grades: 10th and 11th

Subject(s)	Science
Grade/Course	Grades 10 and 11 / Honors/College Prep Chemistry
Unit of Study	Unit 9: Thermochemistry and Nuclear Chemistry
Pacing	3 Weeks

CT State Standards
What are the goals of this unit?

Priority/Focus Standards:
Reading

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words

8. Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently

Writing

1. Write arguments focused on discipline-specific content.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically

6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

7. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

8. Draw evidence from informational texts to support analysis, reflection

9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Supporting Standards:

CT.1. Algebraic Reasoning: Patterns and Functions: Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies.

CT.1.1 1.1. Students should understand and describe patterns and functional relationships.

NGSS Standards:

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

Correspondence to CT Core Standards *What are the goals of this unit?*
Reading: Students will be able to read textbooks and analyze and/or accurately interpret information stem. **Writing:** Students will be able to write organized lab reports coherently, accurately, including data tables and graphs (as needed) with correct grammar and, most importantly, a valid conclusion. **Math:** Students will be able to perform calculations employing algebra, scientific notation, and dimensional analysis in solving problems as needed. Students will be able to convert units of measurement in the metric system.

Unwrapped Priority Standards	
Skills/Suggested Outcomes *What must students **do**?*	**Concepts** *What must students **know**?*
1. Students must be able to calculate the amount of energy gained or lost of a known mass of a substance that undergoes a change in temperature.	1. Students must know the equation $q = mc\Delta t$. q represents a quantity of heat energy gained or lost, m represents the mass in grams of a substance, c represents specific heat and Δt represents the change in temperature.
2. Students must be able to experimentally determine the specific heat of a sample of a metal.	2. Students must know how to construct a calorimeter, using Styrofoam cups, a thermometer, and cardboard. A calorimeter is an insulated device used to measure temperature changes in a substance. Students must also know that specific heat is the amount of heat lost or gained to change the temperature of one gram of a substance by one degree Celsius.
3. Students must be able to calculate the heat lost or gained	3. Students must know what a "heat of formation" of a

in a chemical reaction using Hess's Law. Students must be able to use Hess's Law to calculate the overall heat of reaction also known as ΔH.	compound is and how to apply this numerical information in Hess's Law to calculate the value of the heat of reaction. (ΔH)
4. Students must be able to identify a chemical reaction as exothermic or endothermic based on the result of a calculation of ΔH of the reaction using Hess's Law.	4. An exothermic reaction releases energy from the during the reaction and has a negative value of ΔH while an endothermic reaction absorbs energy and has a positive value for ΔH
5. Students must be able to define radiation.	5. Radiation is the emission of particles or energy from the nucleus of an atom in the process of becoming more stable.
6. Students must be able to identify the different types of radiation and the changes that take place in the nucleus of a radioactive atom because of being radioactive.	6. Alpha radiation particles are composed of two protons and two neutrons. When emitted from the nucleus of an atom, the atomic number of the atom decreases by two and its atomic mass number decreases by four. Beta radiation particles are formed in the nucleus of an atom when a neutron loses an electron that is then emitted from the atom, leaving an additional proton in the nucleus. The atomic number increases by one and the atomic mass number remains unchanged. Gamma radiation, a very high energy form of light, when released from the nucleus of an atom, lowers the energy level of the nucleus making it more stable.
7. Students must be able to define half-life.	7. A half-life is the time that it takes for half of an original amount, or some amount of a radioactive element, to decay.
8. Students must be able to perform a series of multiple	8. Students must know the changes in the nucleus of an

radioactive decays of a radioactive element making a poster model of the changes in the nucleus of an atom and the resulting atom's identity in each step of the decay. 9. Students must be able to determine the remaining amount of an element after a specified number of half-lives, given the half-life of the radioactive element, the time span of the decay process. and the original amount of the element. 10. Students must be able to draw a diagram and write an explanation of what occurs in nuclear fission and nuclear fusion.	atom that occur in alpha and beta decay and the overall change in the resulting atom, including the identity of the atom. 9. Students must know how to draw a flowchart diagram illustrating the amount of a radioactive element after one half life. This is repeated for the specified number of given half-lives. 10. Students must know the differences between nuclear fission and nuclear fusion: what types of atoms are involved in these processes, how the reactions are started, what, if any, waste is produced, and the comparative energy produced in each process.

Essential Questions *What essential questions will be considered?*	**Corresponding Big Ideas** *What understandings are desired?*
1. How do we determine the amount of heat absorbed or released in a temperature change of a substance not involved in a chemical reaction? 2. How do we determine the heat absorbed or released in a chemical reaction?	1. Calculation of the quantity heat indicates the heat energy is being absorbed or released by a substance undergoing a temperature change. This requires using the specific heat of the substance, mass of the substance and knowing the temperature change that takes place. 2. Hess's Law uses heats of formation of the reactant chemicals and chemical products of the reaction to calculate the heat of reaction known as ΔH. A negative value of ΔH indicates that heat energy is being released because of the reaction and a positive value of ΔH

	indicates that heat energy is being absorbed during the reaction.
3. What are the types of radiation that can be emitted from the nuclei of atoms?	3. Radiation that can be emitted from the nuclei of atoms includes alpha particles, beta particles, positrons and gamma waves. Alpha (α) particles are composed of 2 protons and 2 neutrons. Beta (**β**) particles are high speed electrons emitted from the nucleus of an atom. Positrons (**β**+) are positive subatomic charged particles with the same mass and magnitude of charge as an electron. It is sometimes referred to as an anti-electron particle. Gamma (ɣ) radiation is a very high energy light having very short wavelengths and very high frequencies.
4. What is radioactive decay?	4. Radioactive decay is the process in which a radioactive atom spontaneously gives off radiation in the form of particles or energy to reach a more stable state and also resulting in a different element that is more stable. An atom can undergo multiple decays to eventually reach a stable condition.
5. What elements undergo radioactive decay?	5. Radioactive decay is seen in all isotopes of all elements of atomic number 83 (bismuth) or greater.
6. What are types of radioactive decay?	6. The types of radioactive decay are alpha decay. beta decay and gamma decay. Alpha decay emits an alpha particle from the nucleus of a radioactive element. The result is a decrease in the atomic number of the new element formed in the decay by two and the mass of the new element decreasing by four. Beta decay involves a

	neutron in the nucleus emitting a beta particle, leaving a remaining proton. This results in the atomic number of the new element formed in the decay increasing by one with the atomic mass remaining unchanged.
7. What is a half-life of a radioactive element?	7. A half-life of a radioactive element is the amount of time it takes for one half of an amount of a radioactive element to undergo radioactive decay.
8. What is the difference between nuclear fission and nuclear fusion?	8. Fission is the splitting of a heavy, unstable nucleus by a neutron into two lighter nuclei, and fusion is the process where two light nuclei are fused together releasing vast amounts of energy. Nuclear fission produces very large amounts of energy and many radioactive waste particles. Fission also releases neutrons to continue a chain reaction of more atoms undergoing fission. On the other hand, nuclear fusion releases multiple times the amount of energy compared to fission and does not produce radioactive waste. To start a fusion reaction, very large amounts of energy are needed, such as the energy from a fission reaction, to start and then continue the fusion process. This energy is required to overcome the force of repulsion of the protons in the nuclei of the fusing atoms.

Resources
Student Technology Integration and Correspondence to ISTE Standards: 1.1 Empowered Learner Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1.2 Digital Citizen
Students recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

1.3 Knowledge Constructor
Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

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Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Informational Texts and/or Media:

- *Chemistry: Principles and Reactions* by Hurley and Masterson
- *Modern Chemistry* by Raymond E. Davis
- *Problem Solving for Chemistry* by Edward I. Peters

Online Resources / Websites:
- half life problem solving video
- Nuclear chemistry PowerPoint

Vocabulary/Terminology

Vocabulary/Terminology with Definitions:

1. **calorie -** The amount of heat required to raise the temperature of one gram of water 1.00 degree Celsius.

2. **joule -** a unit of heat energy. One calorie = 4.184 joules.

3. **specific heat -** The amount of heat energy required to raise the temperature of one gram of a substance one degree Celsius.

4. **enthalpy -** The measurement of energy in a thermodynamic system, such as a chemical reaction. The quantity of enthalpy equals the total content of heat energy of a system.

5. **endothermic reaction - A** chemical reaction that absorbs heat from its environment.

6. **exothermic reaction -** A chemical reaction that releases heat into its environment.

7. **Hess's Law -** Allows the enthalpy change (ΔH) for a chemical reaction to be calculated even when it cannot be measured directly. This is accomplished by performing basic algebraic operations based on the balanced chemical equation of a reaction. The equation for Hess's Law is: $\Delta H = \sum H_f$ of the products - $\sum H_f$ of the reactants. (H_f is the heat of formation of a compound) and ΔH is the total amount of heat either absorbed in or released from a chemical reaction. (the symbol $\sum$ means "the sum of".)

8. **heat of formation -** The amount of heat absorbed or released when one mole of a compound is formed from its needed elements, each substance being in its normal physical state (gas, liquid, or solid).

9. **radioactive decay -** The process where a radioactive atom spontaneously emits radiation in the form of particles or light energy to become more stable.

10. **alpha decay -** A form of radioactive decay where an atom emits an alpha particle from its nucleus. An alpha particle is composed of two protons and two neutrons.

11. **beta decay -** A form of radioactive decay where an atom emits a beta particle from its nucleus. A beta particle is the result of a neutron in the atom's nucleus emits a high energy electron. This results in an increase of one proton in the nucleus which changes the identity of the atom. The atomic mass number does not change.

12. **gamma decay -** A process where the nucleus emits energy in the form of gamma waves of light. Gamma light is very high in energy because of its very high frequency and very short wavelength.

13. **positron -** A beta particle that has a positive charge ($\boldsymbol{\beta}^{+1}$) and the same mass as an electron. It is sometimes described as an anti-electron.

14. **half Life** - the amount of time it takes half of a number of radioactive atoms of an element to decay to a more stable condition.

15. **nuclear fission -** A process where a heavy and large radioactive atom is split into two or more smaller and lighter atoms after being struck by a neutron. A large amount of energy is released in nuclear fission. The splitting of the atom also releases neutrons that can strike other atoms and cause fission of them. If the concentration of fissionable atoms is high enough, a very fast chain reaction of fission will occur where large numbers of neutrons are emitted and split other atoms which also release more neutrons to continue the process of fission to continue very rapidly.

16. **critical mass -** The minimum number of fissionable atoms that will support a self-sustaining chain reaction of nuclear fission. At this mass, the neutrons released as a product of one fission reaction can cause neighboring atoms to fission.

17. **nuclear fusion -** A process where the nuclei of two small, light atoms are forced to fuse together to produce a larger heavier atom. Fusion requires a very large amount of energy to be applied to the two fusing nuclei and cause them to fuse together. Nuclear fusion produces multiple times the amount of energy that nuclear fission and no radioactive waste as produced in fission.

Learning Plan

Overview and Key Learning Events and Instruction Per Week

Learning Tasks Per Week (Including Instructional Strategies)

Week 1: After an introduction to heat measurement and the equation $q = mc\Delta t$, students will perform a lab experiment requiring they construct a calorimeter and determine the specific heat of a sample of an unknown metal and identify the metal using their calculated value of the specific heat. The next class will be used to review the lab results. Following the review, notes will be given on how to use Hess's law to calculate the heat of reaction. Practice problems will be assigned and due the first class of week two. This will be followed by performing an experiment to determine the heat of reaction of a reaction between an acid and a base, with the calculations and results of the lab due by the second class of week two.

Week 2: This week begins with a review of the Hess's Law practice problems assigned last week. Students will then be assigned to write a minimum of two pages research paper on the history of the use of radiation in medicine. The paper will be due in the next

class period. This will be used as a formative quiz leading into the section of this unit dealing with nuclear chemistry. Students will be given time to begin their research for the paper during class. Students will be informed that the Unit summative assessment will take place at the end of week three.
Week 3: The students will be shown the nuclear chemistry PowerPoint presentation. The video about half life will also be shown during the and practice problems regarding half-life will be done. Following this, the class will be given a test outline for a summative assessment on thermochemistry and nuclear chemistry. A comprehensive review for the summative test will then be done. As previously announced, the summative assessment will take place in the last class of the week.

Westbrook Public Schools' Portrait of a Graduate Learning Expectations
The Westbrook Student will meet expectations by… ☒ Critically Problem Solving ☒ Effectively Communicating ☒ Creatively Thinking ☒ Persevering ☐ Socially Aware ☐ Responsibly Making Decisions

Expected Differentiation, Enrichment, and/or Learner Support
Differentiation (Tier 1): Student accommodations in IEPs or 504 plans such as preferential seating, extended time on assessments or lab reports, and note outlines will be followed. Also, assessments will be designed to be suitable for ability levels of students in College Prep Chemistry and Honors Chemistry.
Enrichment: Students who need to be challenged more will become responsible for higher level subject content. For example, an equation to use in solving half-life problems will be taught. The equation includes the use of *natural logs* rather than logs.

Learner Support (School-wide): Aperture is used to survey the social-emotional needs of all WHS students' school-wide.

Assessments

Include an overview of authentic assessments

Formative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

History of the Use of Radiation in Medicine Paper

Directions: Your task is to write a research paper on the history of the use of radiation in medicine. The paper must be a minimum of 2 pages in length and also include a listing or your sources of information.

The research paper should include dates of the medical use, the types of radiation employed, the source of the radiation, and the names of any physicians that used it, if available. It should also include what medical conditions were treated with it.

Summative Assessments and Corresponding PoG / Teacher Created Rubrics when Applicable:

Summative Assessment of Unit 9
Thermochemistry and Nuclear Chemistry

Directions: You must show all work when solving problems and answers must be labeled with units in order to receive credit for the problem!

1. a. How much heat is required to raise the temperature of 204 grams of lead from 22.8 'C to 64.9 'C?
   8 points

   b. To what temperature will 454 grams of nickel be raised or lowered, if, beginning at 45.0 'C it loses 3138 joules of heat? 8 points

2. Calculate ΔH for each of the following chemical reactions and identify them as exothermic or endothermic.

a. $2\ NO_{(g)} + O_{2\,(g)} \longrightarrow 2\ NO_{2\,(g)}$, 20 points

b. $Fe_2O_{3\,(s)} + 3\ CO_{(g)} \longrightarrow 2\ Fe_{(ss)} + 3\ CO_{2\,(g)}$ 20 points

3. Compare the properties of alpha particles and beta particles. 15 points

4. An atom of 92 ^{238}U undergoes the following series of radioactive decay - alpha, alpha, beta, beta, and finally alpha. Draw a flow chart diagram of each step in the series of decays including the element's symbol (with atomic number and atomic mass number) 20 points

5. a. The half-life of $_{30}^{71}$Zn is 2.4 minutes. If one had 500.0 g at the beginning time, how many grams would be left after 7.2 minutes has elapsed? 10 points

b. Oxygen (atomic mass number of 22) has a half-life of 2.25 seconds. How many half-lives would 500 grams Oxygen - 22 go through to end up with 7.81 grams of oxygen - 22 remaining? 15 points