Englewood Public School District
Science
Grade 8
Third Marking Period

Unit 5: Relationships Among Forms of Energy

Overview: In this unit, students use the practices of *analyzing and interpreting data*, *developing and using models*, and *engaging in argument from evidence* to make sense of relationship between energy and forces. Students develop their understanding of important qualitative ideas about the conservation of energy. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students also understand the difference between energy and temperature, and the relationship between forces and energy. The crosscutting concepts of *scale, proportion, and quantity*, *systems and system models*, and *energy and matter* are called out as organizing concepts for these disciplinary core ideas. Students use the practices of *analyzing and interpreting data*, *developing and using models*, and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Time Frame: 25 to 30 Days

Enduring Understandings:
Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed.
When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
When the kinetic energy of an object changes, energy is transferred to or from the object.

Essential Questions:
How can physics explain sports?
Is it better to have an aluminum (baseball/softball) bat or a wooden bat?
What would give you a better chance of winning a bowling match, using a basketball that you can roll really fast, or a bowling ball that you can only roll slowly?
Who can design the best roller coaster?

Standards	Topics and Objectives	Activities	Resources	Assessments
(<u>MS-PS3-1</u>) **Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.**	**Topics** Forms of Energy Energy Transformations Energy Conservation Twenty-First Century Themes	Students will complete the text activities: 1. Discover Activity (p146) How High Does a Ball Bounce? 2. Discover Activity (p151) What makes a Flashlight shine?	**<u>Text:</u>** Prentice Hall Science Explorer: Motion, Forces, and Energy **<u>Materials:</u>** For Discover Activity (p146) How High Does a Ball	**Formative Assessments:** • Journals • Learning/Response Logs • Discussions • Students' learning needs will be

(MS-PS3-2) **Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** **(MS-PS3-5)** **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.**	and Skills include: • The Four C's • Life and Career Skills • Information and Media literacy **Objectives** Students will: Construct and interpret graphical displays of data to identify linear and nonlinear relationships of kinetic energy to the mass of an object and to the speed of an object. Develop a model to describe what happens to the amount of potential energy stored in the system when the arrangement of objects interacting at a distance changes. Support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Use models to represent the gravitational interactions between two masses.	3. Lab (p156) Can You Feel the Power? 4. Discover Activity (p158) What Would Make a Card Jump? 5. Lab Activity (p162) Pendulum Swing 6. Lab (p164) Soaring Straws Students will view the Soccer - Kick It video to investigate the relationship between the size of a player's leg and how far the ball can be kicked. (MS-PS3-1, WHST.6-8.1) Students will watch the video All the Energy in the Universe is… and trace the path energy in an everyday activity. Students will research to find information on a sport and the physics in that particular sport during the It's All Downhill: Forces and Sports Lesson Plan. (MS-PS3-5) Students will build tracks, ramps, and jumps for the virtual skater and view the kinetic energy, potential energy and friction as he moves in the simulation Energy Skate Park: Basics. (MS-PS3-2, RST.6-8.7, 8.EE.2) Students will test their knowledge by playing the Kinetic vs. Potential Millionaire Game. (SL.8.5)	Bounce? • Meter stick • Tennis ball For Discover Activity (p151) What makes a Flashlight shine? • Flashlight • Batteries For Lab (p156) Can You Feel the Power? • Calculator • Meter stick • Stopwatch • 2.5cm x 30cm x 120cm board • 18-20 books about 2cm each For Discover Activity (p158) What Would Make a Card Jump? • Index card For Lab Activity (p162) Pendulum Swing • Washers • Rubber stopper • String • Ring stand • Clamp For Lab (p164) Soaring Straws • Scissors • Rubber bands • 3 plastic straws • Meter stick • Marker • Metric ruler	assessed based on responses to Discover Activity and Energy Skate Park: Basics discussion questions. • Self-Assessments • Student progress will be assessed base on results of the Kinetic vs Potential Millionaire Game. **Summative Assessments:** Unit quizzes and test Students will receive a grade for answers to analysis questions for the following labs: *Lab (p156) Can You Feel the Power?* and *Lab (p164) Soaring Straws*. Questions, Multiple Choice Students will create a roller coaster model and be able to explain the energy transformations that occur as the "car" travels in the *Design and Build a Roller Coaster (p145) Challenge*. Model/Project, Rubric, Essay, Research **Benchmark Assessments:** • Common Formative Assessment • Exact Path **Additional Assessments:** Students will explain and trace energy transformations

		Students will apply forms of energy and energy transformations to *Design and Build a Roller Coaster (p145)* (8.F.3, CRP4, 8.1.8.A.3, 9.2.8.B.3, 6.1.8.C.4.c) **Enrichment Activity:** Student will explore potential and kinetic energy during the lab activity Rubber Bands for Energy. (8.EE.A.1, CRP8, WHST.6-8.7)	• Balance • Masking tape • Empty toilet paper role For *Design and Build a Roller Coaster (p145)* • Wood • Various objects to create a track **Websites:** • Energy Skate Park: Basics • Kinetic vs. Potential Millionaire Game **Videos:** • Soccer - Kick It • All the Energy in the Universe is… **Enrichment Lesson Plans:** See Rubber Bands for Energy **Additional Resources:** https://www.mrdelemeester.com/science-8-unit-5-relationships-among-forms-of-energy.html	after viewing the video All the Energy in the Universe is… Observation, Recall information, Checklists Students will conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. Observations, Trials, Checklists, Performance Students will use models to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. Models, Interviews, Peer Evaluation

Accommodations and Modifications:

Students with special needs: Support staff will be available to aid students related to IEP specifications. 504 accommodations will also be attended to by all instructional leaders. Physical expectations and modifications, alternative assessments, and scaffolding strategies will be used to support this learning.
The use of Universal Design for Learning (UDL) will be considered for all students as teaching strategies are considered.

ELL/ESL students: Students will be supported according to the recommendations for "can do's" as outlined by WIDA –
https://www.wida.us/standards/CAN_DOs/
This particular unit has limited language barriers due to the physical nature of the curriculum.

Students at risk of school failure: Formative and summative data will be used to monitor student success at first signs of failure student work will be Reviewed to determine support. This may include parent consultation, basic skills review and differentiation strategies. With considerations to UDL, time may be a factor in overcoming developmental considerations. More time and will be made available with a certified instructor to aid students in reaching the standards.

Gifted and Talented Students: Students excelling in mastery of standards will be challenged with complex, high level challenges related to the complexity in planning and carrying out investigations and analyzing and interpreting data.

English Language Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
• Structure the learning around explaining or solving a social or community-based issue. • Speak and display terminology • Teacher modeling • Peer modeling • Provide ELL students with multiple literacy strategies. • Word walls • Use peer readers • Give page numbers to help the students find answers	• Provide reminders to keep on task • Utilize modifications & accommodations delineated in the student's IEP • Work with paraprofessional • Use multi-sensory teaching approaches. • Work with a partner • Provide concrete examples • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA). • Provide students with multiple choices for how they can	• Provide opportunities for review and practice • Using visual demonstrations, illustrations, and models • Give directions/instructions verbally and in simple written format. Oral prompts can be given. • Peer Support • Increase one on one time • Teachers may modify instructions by modeling what the student is expected to do • Instructions may be printed out in large print and hung up for the student to see during the time of the lesson.	• Structure the learning around explaining or solving a social or community-based issue. • Curriculum compacting • Inquiry-based instruction • Independent study • Higher order thinking skills • Adjusting the pace of lessons • Interest based content • Real world scenarios • Student Driven Instruction • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science

• Provide a computer for written work • Provide two sets of textbooks, one for home and one for school • Provide visual aides • Provide additional time to complete a task • Use graphic organizers	represent their understandings (e.g. multisensory techniques- auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).	• Review behavior expectations and make adjustments for personal space or other behaviors as needed. • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).	learning to connect science with observable phenomena. • Collaborate with after-school programs or clubs to extend learning opportunities.

Interdisciplinary Connections:

ELA-NJSLS/ELA:

WHST.6-8.1: Write arguments focused on discipline content. *(MS-PS3-5)*

WHST.6-8.7: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS3-3)

SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS3-2)*

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS3-1)

Mathematics:
8.EE.A.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)
8.EE.A.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. Know that $\sqrt{2}$ is irrational. (MS-PS3-1)
8.F.A.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. (MS-PS3-1), (MS-PS3-5)

Career Ready Practices:
CRP4: Communicate clearly and effectively and with reason.
CRP8: Utilize critical thinking to make sense of problems and persevere in solving them.

Integration of Technology Standards NJSLS 8:
8.1.8.A.3: Use and /or develop a simulation that provides an environment to solve a real world problem or theory.

Integration of 21st Century Standards NJSLS 9:
9.2.8.B.3
Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

Social Studies:
6.1.8.C.4.c: Analyze how technological innovations affected the status and social class of different groups of people, and explain the outcomes that resulted.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Analyzing and Interpreting Data** • Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) **Engaging in Argument from Evidence** • Construct, use, and present oral and written	**PS3.A: Definitions of Energy** • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer**	**Scale, Proportion, and Quantity** • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1) **Systems and System Models** • Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows

arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5) - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3-5)	• When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) **PS3.C: Relationship Between Energy and Forces** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	within systems. (MS-PS3-2) **Energy and Matter** • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)

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Unit 6: Thermal Energy

Overview: In this unit, students *ask questions*, *plan and carry out investigations*, *engage in argument from evidence*, *analyze and interpret data*, *construct explanations*, *define problems and design solutions* as they make sense of the difference between energy and temperature. They use the practices to make sense of how the total change of energy in any system is always equal to the total energy transferred into or out of the system. The crosscutting concepts of *energy and matter*, *scale, proportion, and quantity*, and *influence of science, engineering, and technology on society and the natural world* are the organizing concepts for these disciplinary core ideas. Students ask *questions*, *plan and carry out investigations*, *engage in argument from evidence*, *analyze and interpret data*, *construct explanations*, *define problems and design solutions.* Students are also expected to use these practices to demonstrate understanding of the core ideas.

Time Frame: 15-20 Days

Enduring Understandings:
The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

Essential Questions:
How can a standard thermometer be used to tell you how particles are behaving?

Standards	Topics and Objectives	Activities	Resources	Assessments
(MS-PS3-3) **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.** **(MS-PS3-4)** **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** **(MS-ETS1-1)** **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** **(MS-ETS1-2)** **Evaluate competing design**	**Topics** Temperature Thermal Energy Heat Heat Transfer Twenty-First Century Themes and Skills include: • The Four C's • Life and Career Skills • Information and Media literacy **Objectives** Students will: Determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of particles as measured by the temperature of the sample. Apply scientific ideas or principles to design, construct, and test a design of a device that either minimizes or maximizes thermal energy transfer.	Students will complete the text activities: 1. Discover Activity (p176) How Cold Is the Water? 2. Lab (p182) Build Your Own Thermometer 3. Discover Activity (p183) What Does It Mean to Heat Up? 4. Lab Activity (p184) Feel the Warmth 5. Lab (p188) Just Add Water 6. Discover Activity (p190) What Happens to Heated Metal? 7. Discover Activity (p195) What Happens at the Pump? 8. Lab Activity (p196) Shake it Up (RST.6-8.1, WHST.6-8.7) Students will watch the video Can Humans Really Feel Temperature? and Bill Nye Heat to be introduced to the topic of thermal energy. (CRP4, MS-PS3-4) Students will explore heat transfer and build their own systems in the simulation Energy Forms and Changes. (MS-PS3-3, CRP6, RST.6-8.7) Students will interact with the	**Text:** Prentice Hall Science Explorer: Motion, Forces, and Energy **Materials:** For Discover Activity (p176) How Cold Is the Water? • 3 bowls • Cold water • Warm water • Room temperature water For Lab (p182) Build Your Own Thermometer • Bowl of hot water • Bowl of ice water • Water of unknown temperature • Tap water • 500-mL beaker • Clear glass juice or soda bottle, 20-25 cm • Clear plastic straw, 18-20 cm • Food coloring • Plastic dropper • Cooking oil • Modeling clay • Metric ruler • Fine-point marker For Discover Activity (p183) What Does It Mean to Heat Up?	**Formative Assessments:** • Journals • Learning/Response Logs • Discussions • Students' learning needs will be assessed based on responses to Discover Activity and Energy Forms and Changes discussion questions. **Summative Assessments:** Unit quizzes and test Students will receive a grade for answers to analysis questions for the following labs: *Lab (p182) Build Your Own Thermometer* and *Lab (p188) Just Add Water.* Students will be evaluated based on design principles for their *Chapter Project (p175) In Hot Water*. Project Design, Rubric **Benchmark Assessment:** See Unit 5 for quarterly assessment **Alternative Assessment:** Students will design solutions

solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **(MS-ETS1-3) Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.** **(MS-ETS1-4) Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**		States of Matter virtual simulation and view molecules form a solid, liquid, or gas as heat is added or removed. (MS-PS3-4, CRP4, RST.6-8.3) Students design a device that minimizes heat loss in the Chapter Project (p175) In Hot Water based on the following scenario: *You are an engineer working for NASA. In preparation for a manned space mission to the Moon, you are tasked with designing, constructing, and testing a device that will keep a hot beverage hot for the longest period of time. It costs approximately $10,000 per pound to take payload into orbit so the devise must be lightweight and compact. The lack of atmosphere on the Moon produces temperature extremes that range from -157 degrees C in the dark to +121 degrees C in the light. Your devise must operate on either side of the Moon.* (MS-ETS1-1, MS-ETS1-3, MS-ETS1-4, RST.6-8.9, WHST.6-8.9, 8.F.B.5, 9.2.8.B.3) **Enrichment Activity:** Students will engineer a thermos in the Keep It Cool activity. (MS-ETS1-2, 8.1.8.A.3, 8.EE.A.4, 6.1.8.C.4.c)	• Utensils made of different materials • Beaker • Frozen butter • Hot water For Lab Activity (p184) Feel the Warmth • Lamp without shade For Lab (p188) Just Add Water • Hot tap water • Balance • Scissors • Pencil • 4 plastic foam cups • 2 thermometers • Beaker of water kept in ice bath For Discover Activity (p190) What Happens to Heated Metal? • 1 m metal wire • Ring stand • Clamp • Several washers • Candle • Matches • Oven mitt For Discover Activity (p195) What Happens at the Pump? • Bicycle pump • Deflated basketball or soccer ball For Lab Activity (p196) Shake it Up	and modify them on the basis of the test results in order to improve them. Project Design, Model, Rubric, Checklist

		• Dry sand • Metal container with a cover • Thermometer **Websites:** • Energy Forms and Changes • States of Matter • *Moon Information* **Videos:** • Can Humans Really Feel Temperature? • Bill Nye Heat **Enrichment Lesson Plans:** See Keep It Cool

Accommodations and Modifications:

Students with special needs: Support staff will be available to aid students related to IEP specifications. 504 accommodations will also be attended to by all instructional leaders. Physical expectations and modifications, alternative assessments, and scaffolding strategies will be used to support this learning.
The use of Universal Design for Learning (UDL) will be considered for all students as teaching strategies are considered.

ELL/ESL students: Students will be supported according to the recommendations for "can do's" as outlined by WIDA – https://www.wida.us/standards/CAN_DOs/
This particular unit has limited language barriers due to the physical nature of the curriculum.

Students at risk of school failure: Formative and summative data will be used to monitor student success at first signs of failure student work will be Reviewed to determine support. This may include parent consultation, basic skills review and differentiation strategies. With considerations to UDL, time may be a factor in overcoming developmental considerations. More time and will be made available with a certified instructor to aid students in reaching the standards.

Gifted and Talented Students: Students excelling in mastery of standards will be challenged with complex, high level challenges related to the complexity In planning and carrying out investigations and analyzing and interpreting data.

English Language Learners	Special Education	At-Risk	Gifted and Talented
• Provide highlighters for identifying important directions • Speak and display terminology • Teacher modeling • Peer modeling • Provide ELL students with multiple literacy strategies. • Word walls • Use peer readers • Give page numbers to help the students find answers • Provide a computer for written work • Provide two sets of textbooks, one for home and one for school • Provide visual aides • Provide additional time to complete a task • Use graphic organizers	• Provide highlighters for identifying important directions • Utilize modifications & accommodations delineated in the student's IEP • Work with paraprofessional • Use multi-sensory teaching approaches. • Work with a partner • Provide concrete examples • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA). • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).	• Provide opportunities for at home tests • Using visual demonstrations, illustrations, and models • Give directions/instructions verbally and in simple written format. Oral prompts can be given. • Peer Support • Increase one on one time • Teachers may modify instructions by modeling what the student is expected to do • Instructions may be printed out in large print and hung up for the student to see during the time of the lesson. • Review behavior expectations and make adjustments for personal space or other behaviors as needed. • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital	• Students can act as peer support as needed • Inquiry-based instruction • Independent study • Higher order thinking skills • Adjusting the pace of lessons • Interest based content • Real world scenarios • Student Driven Instruction • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Collaborate with after-school programs or clubs to extend learning opportunities.

		tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).	

Interdisciplinary Connections:

ELA-NJSLS/ELA:

RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. (MS-PS3-5),(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)

RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4)

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS3-3),(MS-PS3-4),(MS-ETS1-3)

RST.6-8.9: Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)

WHST.6-8.7: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)

WHST.6-8.8: Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1)

WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4)

Mathematics:
8.F.B.5: Sketch a graph that exhibits the qualitative features of a function that has been described verbally
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 (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

Career Ready Practices:
CRP4: Communicate clearly and effectively and with reason.
CRP6: Demonstrate creativity and innovation.

Integration of Technology Standards NJSLS 8:
8.1.8.A.3: Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

Social Studies:
6.1.8.C.4.c: Analyze how technological innovations affected the status and social class of different groups of people, and explain the outcomes that resulted.

Integration of 21st Century Standards NJSLS 9:
9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Constructing Explanations and Designing Solutions** • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Asking Questions and Defining Problems** • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1) **Developing and Using Models** • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-	**PS3.A: Definitions of Energy** • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer** • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) **ETS1.A: Defining and Delimiting Engineering Problems** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely	**Scale, Proportion, and Quantity** • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-4) **Energy and Matter** • The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3) **Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

ETS1-4) **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) **Engaging in Argument from Evidence** • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	to limit possible solutions. (MS-ETS1-1) **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) • Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	