Englewood Public School District
Science
Chemistry
First Marking Period

Unit 1: Structure and Properties of Matter

Overview: In this unit of study, students use investigations, simulations, and models to makes sense of the substructure of atoms and to provide more mechanistic explanations of the properties of substances. Students are able to use the periodic table as a tool to explain and predict the properties of elements. Students are expected to communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. The crosscutting concepts of *structure and function*, *patterns*, and *stability and change* are called out as the framework for understanding the disciplinary core ideas. Students use *developing and using models*, *planning and conducting investigations*, *using mathematical thinking*, and *constructing explanations and designing solutions*. Students are also expected to use the science and engineering practices to demonstrate proficiency with the core ideas.

Time Frame: 40 to 45 Days

Enduring Understandings:
An atom's nucleus is made of protons and neutrons and is surrounded by electrons.
The periodic table orders elements horizontally by number of protons in the nucleus of each element's atoms and places elements with similar chemical properties in columns.
Patterns of electrons in the outermost energy level of atoms can provide evidence for the relative properties of elements.
Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

Essential Questions:
How can the substructures of atoms explain the observable properties of substances?
How can a periodic table tell me about the subatomic structure of a substance?
How can I use the properties of something to predict what is happening with the subatomic particles?
How can chemistry be used to help make "greener" choices for products?

Standards	Topics and Objectives	Activities	Resources	Assessment
(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**	**Topics** Introduction to Chemistry Properties of Matter	Students will complete the investigations, labs, and activities: 1. Watch Untamed Science Chapters 1-6 video introduction via	**Text:** Pearson Chemistry **Materials:** *See investigations, labs and activities material lists*	**Formative Assessments:** • Discussions • Journals • Response Logs • Student portfolios will be used to monitor

level of atoms.

(HS-PS1-3)
Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

(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.

(HS-PS2-6)
Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

(HS-ETS1-3)
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental

Structure of Matter (Atoms)

Electron Configuration

Periodic Table

Twenty-First Century Themes and Skills include:

- The Four C's
- Life and Career Skills
- Information and Media literacy

Objectives

Students will:

Use the periodic table as a model to predict the structure and relative properties of elements.

Communicate scientific and technical information about why the molecular - level structure is important in the functioning of designed materials.

https://www.successnetplus.com/

2. Lab Safety hands on activity
3. Density of several wooden cubes and four metal cylinders
4. Graph the Research Data of DuLong & Petit (circa. 1890)
5. Paper Chromatography of an ink mixture
6. Separating a complex mixture by sedimentation, filtration, crystallization, and distillation
7. Reaction of Copper Sulfate solution with Zinc metal
8. Reaction of Magnesium Ribbon with Water
9. Teacher activity – Demonstration of the Crooke's Tube
10. Lab - Emission Spectroscopy
11. Drawing the Diagonal Rule Chart
12. Emission Lines of Hydrogen using Balmer's, Planck's, and Einstein's equations
13. Lab - Flame Test
14. Lab - The Periodic Law
15. Heat of Fusion for Ice
16. Graphing the First Ionization Energy of the first Twenty Elements

Students will review lab safety in the video Lab Techniques & Safety.

For Density Activity:

- Wood Blocks
- Four Metals Cylinders
- Beakers
- Digital Scales
- Vernier Calibers
- Metric Rulers

For Teacher activity – Demonstration of the Crooke's Tube

- Crooke's Tube kit

For Lab - Emission Spectroscopy

- Emission tube kit

For Emission Lines of Hydrogen using Balmer's, Planck's, and Einstein's equations

- Emission line kit

For Lab - Flame Test

- Bunsen burner

For Radioactive Decay

- 1 coin per student
- 1 balloon per student

For Path to Periodic Table

- Periodic Table Cards

Websites:

- Chemistry Science Starters
- Build an Atom
- Isotopes and Atomic Mass
- Periodic Table Trends

progress.

- Students will communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials in the *Chapter 1 CHEMYSTERY: Is Bio Better?* and Conflicts in Chemistry: The Case of Plastics debate.

Summative Assessments:

- Student needs will be evaluated after completing the *Lab Safety hands on activity* and the *Path to Periodic Table* activity.
- Students will receive a grade for the following lab activity conclusions: *Lab - Emission Spectroscopy, Lab - Flame Test,* and *Lab - The Periodic Law.*

Benchmark Assessment:
A Common Formative Assessment will be given at the close of this unit to assess students' mastery of the skills identified.

impacts. **(HS-ETS1-4)** **Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.**		Students will be challenged with Chemistry Science Starters to solve density, element, periodic table, and atomic math trivia. (HS-PS1-1 NJSLSA.R1,) Students will watch the videos History of Atomic Chemistry, The Nucleus, and The Electron to introduce the atom. Students will create different models of atoms and provides evidence that protons determine the identity of the element in the Build an Atom online simulation. (HS-PS1-3, HS-ETS1-4, MP.2, MP.4, CRP8) Students will learn about isotopes and how abundance relates to the average atomic mass of an element in the simulation Isotopes and Atomic Mass. (NJSLSA.W7) Students will simulate Radioactive Decay with a kinesthetic activity. Student will watch Nuclear Chemistry Part 1 and Nuclear Chemistry Part 2 to review fission, fusion, and radioactive decay. (8.2.12.A.2) Students make sense of how	• https://www.successnetplus.com/ **Videos:** • Lab Techniques & Safety • History of Atomic Chemistry • The Nucleus • The Electron • Nuclear Chemistry Part 1 • Nuclear Chemistry Part 2 • Developing the Periodic Table **Enrichment Lesson Plans:** See Castle of Mendeleev and Detecting Radiation in our Radioactive World activities.	**Alternative Assessments:** • Written questions and answers • Practice Presentations • Graphic Organizers • Peer Assessments • Students will use mathematical models and/or computer simulations to show why the molecular level structure is important in the functioning of designed materials. • Students will observe patterns in the outermost electron states of atoms, trends in the periodic table, and chemical properties. • Students will use valid and reliable evidence (obtained from students' own investigations, models, theories, simulations, and peer review) showing the outermost electron states of atoms, trends in the periodic table, and patterns of chemical properties to construct and revise an explanation for the outcome of a simple chemical reaction.

and why the periodic table is organized the way that it is in the activity Path to Periodic Table using Periodic Table Cards.
(NJSLSA.W5, CRP4)

Students will watch the video Developing the Periodic Table and answer discussion questions.
(NJSLSA.W9)

Students will conduct a virtual investigation of Periodic Table Trends.

Students will debate the use of plastics in the Chapter 1 CHEMYSTERY: Is Bio Better? and the role-playing activity Conflicts in Chemistry: The Case of Plastics. (6.1.12.C.3.a)

Enrichment Activities:
Students engage in a fantasy world in the Castle of Mendeleev activity that requires them to make claims, based on evidence, regarding the identity of unknown materials.
(NJSLSA.W8, 8.2.2.C.1, 9.3.ST.2, 8.2.12.C.4)

Students will make atoms visible and explore radiation in the Detecting Radiation in our Radioactive World activities.
(N-Q.A.1, CRP6)

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**
● Pre-teach vocabulary ● 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 highlighters to identify important key words ● 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	● Provide opportunities for review ● 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	● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. ● 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 ● Use project-based science learning to connect science

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

Interdisciplinary Connections:

ELA-NJSLS/ELA:

NJSLSA.R1: Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. RST.11-12.1 (HS-PS1-3)

NJSLSA.W5: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. WHST.9-12.5 (HS-ETS1-3)

NJSLSA.W7: Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation. WHST.9-12.7 (HS-PS1-3)

NJSLSA.W8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. WHST.11-12.8 (HS-PS1-3), (HS-ETS1-3)

NJSLSA.W9: Draw evidence from literary or informational texts to support analysis, reflection, and research. WHST.9-12.9 (HS-PS1-3), (HS-ETS1-3)

Mathematics:
MP.2: Reason abstractly and quantitatively. (HS-PS1-8), (HS-ETS1-3), (HS-ETS1-4)
MP.4: Model with mathematics. (HS-ETS1-3), (HS-ETS1-4)
N-Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-3)

Integration of 21st Century Skills:
9.3.ST-ET.2: Display and communicate STEM information.
9.3.ST.2: Use technology to acquire, manipulate, analyze and report data.

Career Ready Practices:
CRP6: Demonstrate creativity and innovation**.**
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:
8.2.12.A.2: Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
8.2.12.C.4: Explain and identify interdependent systems and their functions.

Social Studies:
6.1.12.C.3.a: Analyze how technological developments transformed the economy, created international markets, and affected the environment in New Jersey and the nation.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) **Planning and Carrying Out Investigations** • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)	**PS1.A: Structure and Properties of Matter** • Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) • The structure and interactions of matter at the bulk scale are determined by electrical	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3) **Structure and Function** • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6) **Systems and System Models**

Constructing Explanations and Designing Solutions

- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

Obtaining, Evaluating, and Communicating Information

- Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)

Using Mathematics and Computational Thinking

- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

forces within and between atoms. (*secondary to HS-PS2-6*)

PS1.B: Chemical Reactions

- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2)

PS2.B: Types of Interactions

- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. *(secondary to HS-PS1-1),(secondary to HS-PS1-3)*

ESS2.D: Weather and Climate

- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-4)

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Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World**

New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3)