Pascack Valley Regional High School District

Pascack Hills High School, Montvale, New Jersey
Pascack Valley High School, Hillsdale, New Jersey

Course Name: Chemistry in the Community

Born On: August, 2015
Revised On: August, 2020
Revised On: August, 2022
Current Revision: August, 2023
Board Approval: 8/28/2023

New Jersey Curricular Mandates for Science Instruction

Disabled & LGBT:
18A:35-4.35 - History of disabled and LGBT persons included in middle and high school curriculum. A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards.

Diversity, Equity, and Inclusion (DEI):
C.18A:35-4.36a - Curriculum to include instruction on diversity and inclusion. 1. a. Beginning in the 2021-2022 school year, each school district shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards. b. The instruction shall: (1) highlight and promote diversity, including economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance; (2) examine the impact that unconscious bias and economic disparities have at both an individual level and on society as a whole; and (3) encourage safe, welcoming, and inclusive environments for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs. c. The Commissioner of Education shall provide school districts with sample learning activities and resources designed to promote diversity and inclusion.

Amistad Law:
N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

Climate Change:
2020 NJSLS-Science: Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. Global climate change has already resulted in a wide range of impacts across New Jersey and in many sectors of its economy. The addition of academic standards that focus on climate change is important so that all students will have a basic understanding of the climate system, including the natural and human-caused factors that affect it. The underpinnings of climate change span across physical, life, as well as Earth and space sciences. The goal is for students to understand climate science as a way to inform decisions that improve quality of life for themselves, their community, and globally and to know how engineering solutions can allow us to mitigate impacts, adapt practices, and build resilient systems.

Dissection Law
N.J.S.A. 18A:35-4.25 and N.J.S.A. 18A:35-4.24 authorizes parents or guardians to assert the right of their children to refuse to dissect, vivisect, incubate, capture or otherwise harm or destroy animals or any parts thereof as part of a course of instruction.

Chemistry in the Community

Unit 1: Water and Chemistry Measurements

Time Allotted: Approximately 8 Weeks

New Jersey Student Learning Standards (NJSLS)

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-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems
HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).

Science & Engineering Practices

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.

Constructing Explanations and Designing Solutions

- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Using Mathematics and Computational Thinking

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

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)*

ESS2.C: The Roles of Water in Earth's Surface Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.

ESS2.D: Weather and Climate

- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. *(secondary)*

ESS3.C: Human Impacts on Earth Systems

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

ESS3.D: Global Climate Change

- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the

Cross-Cutting Concepts

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.

Structure and Function

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system.

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering

	atmosphere, and the biosphere interact and are modified in response to human activities. **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. *(secondary)*	design practices to increase benefits while decreasing costs and risks.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What pollutants are found in water, how are they measured, and where do they come from? - How can we determine if two substances (i.e. rocks) have the same identity? - What is water pollution? - How can you clean water if you're stranded on a deserted island? - What are the ethical considerations and obligations of companies when disposing of chemical waste? - How do we balance industry and its resulting pollution responsibly, and who do we hold accountable when ethical responsibilities are not fulfilled?	- Predict and measure mass and volume to determine density of water and substances in the environment - Apply computational thinking and dimensional analysis to make unit conversion - Interpret a water quality report and units of ppm and ppb - Use sand, gravel, and activated charcoal to purify a polluted water sample and relate their purifying capabilities to their particle size - Identify common water pollutants and their sources - Evaluate information about the contamination of a Superfund site	- Density of Rocks Lab: Students will use density measurements of rocks found in their environment to determine if they are of the same origin - Foul Water Inquiry Lab: students will use sand, gravel, and activated charcoal to purify a polluted water sample - Read a Water Quality Report from Suez - Water Testing Lab: students will obtain a sample of water from the PV Creek and analyze it for nitrates, phosphates, acidity, turbidity, fecal coliform, and dissolved oxygen - Superfund Site Project: students will research a Superfund site in New Jersey, and evaluate the damage and culpability of parties involved in the contamination Scientist Spotlight: • **Walter Westman** – Pollution Control Act and Clean Water Act.	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of research and presentation skills by building the project, including supporting documentation. - Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test. - Chemistry Benchmark #1
Resources/Materials	- Water Testing Lab Kit - Foul Water Lab Kit - Lab Equipment: balances, graduated cylinders - Superfund Site Online Resources - Presentation Technology: Google Presentation, Prezi, PowerPoint		
ELA Companion Standards	**RST.11-12.1** Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.		

	WHST.9-12.7 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. **WHST.11-12.8** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. **SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. ***Mathematics*** **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities **HSN-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.
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions **9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. **9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. **9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** ● Demonstrate creativity and innovation. ● Utilize critical thinking to make sense of problems and persevere in solving them. ● Model integrity, ethical leadership, and effective management. ● Use technology to enhance productivity, increase collaboration, and communicate effectively. ● Work productively in teams while using cultural/global competence.
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

	8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). **8.2.12.EC.3**: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience. **8.2.12.ETW.4**: Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints

Modifications

Multi-Lingual Learners	Special Education	At-Risk	Gifted and Talented
• Display labeled images of designs and parts. • Provide word banks • Use body movement and gestures to further explain concepts to students. • Restate directions aloud • Assign a native language partner	• Provide adequate scaffolds and template for lab report • Provide word banks • Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency • Partner work • Preferential seating	• Authenticate lab experiences by having students procure materials from environment (i.e.actual creek water to analyze in lab) • Student choice- i.e. allow students to choose Superfund sites to research • Provide peer mentoring to improve techniques.	• Purify water further during foul water lab, and maximize volume of reclaimed water • Create a more detailed report which includes additional research outside of project requirements.

Chemistry in the Community

Unit 2: Atomic Structure & The Periodic Table

Time Allotted: Approximately 4 Weeks

New Jersey Student Learning Standards (NJSLS)

HS-PS-1-1 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-1-7 Use mathematical representations to support the claim that atoms are, and therefore mass, is conserved during a chemical reaction.
HS-PS-2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Developing and Using Models • Use a model to predict the relationships between systems or between components of a system. **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	**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. • 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	**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. **Energy and Matter** • The total amount of energy and matter in closed systems is conserved.

natural world operate today as they did in the past and will continue to do so in the future.

Using Mathematics and Computational Thinking

- Use mathematical representations of phenomena to support claims.

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).

repeating patterns of this table reflect patterns of outer electron states.

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.

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.

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.

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- Why does the periodic table have such a strange shape? - How is the periodic table used to gather information? - Why are some elements reactive, while others are inert?	- Relate the arrangement of electrons in principle energy levels to reactivity of elements - Use the properties of elements to organize them, as a precursor to the full periodic table - Model the ratio of the nucleus to atomic radius based on the Rutherford Model	- Rutherford Lab: Students will use the concept of probability (using marbles as a model) to find that atoms are mostly empty space - Basketball demo: use a basketball as the "nucleus" and model where the radius of the atom would be located - Mendeleev Lab: Students will be given 30 cards containing properties of "unknown" elements. Students will create their own periodic tables by classifying elements as Mendeleev did, by chemical properties - Atomic Mass Lab: Students will measure actual samples of elements and identify the elements based on their atomic masses (note: each sample contains 1 mole) as well as physical properties *Scientist Spotlight*: • **Dr. Krystal Vasquez** – The struggles of inaccessibility for physically	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.

		disabled scientists. - NPR Podcast w/ Dr. Vasquez - "Excluded from the Lab" by Dr. Vasquez • **John Dalton** – Colorblind scientist who worked in Atomic Theory.	
Resources/Materials	- Rutherford Lab Kit (marbles, meter sticks, tape) - Mendeleev Lab (printout of cards) - Atomic Mass Lab (Mole Sample Kit)		
ELA Companion Standards	**RST.9-10.7** 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 **WHST.9-12.5** 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		
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. **SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. ***Mathematics*** **MP.2** Reason abstractly and quantitatively.		
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions **9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. **9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** • Use technology to enhance productivity, increase collaboration, and communicate effectively. • Work productively in teams while using cultural/global competence.		
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.2**: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.		

Modifications			
Multi-Lingual Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
• Write instructions for lab activities	• Provide extended time for the creation of products.	• Provide peer mentoring to improve techniques.	• Provide fewer "clues" during the Mendeleev Lab

on the board • Restate steps • Assign a native language partner. • When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. • Provide a variety of texts and resources on curriculum topics at a range of reading levels. • Provide models of completed homework assignments, projects, etc.	• Get a written list of instructions • Receive large project as smaller tasks with individual deadlines • Work or take a test in a different setting, such as a quiet room with few distractions. • Preferential seating • Use an alarm to help with time management • Work with a partner	• Provide an outline for project tasks. • Incorporate student choice • Use effort and achievement rubrics • Assure students they can be successful • Promote mastery or challenging tasks • Allow students many opportunities for practice and learning • Use scaffolding for complex tasks • Evaluate students on the basis of mastery and not one another. • Classroom activities should be noncompetitive.	• Encourage more sophisticated explanations in labs and open ended questions

Chemistry in the Community

Unit 3: Chemical Compounds and Reactions

Time Allotted: 9 Weeks

New Jersey Student Learning Standards (NJSLS)

HS-PS-1-1 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-1-7 Use mathematical representations to support the claim that atoms, and therefore mass,are conserved during a chemical reaction.
HS-PS-2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials
HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
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 impacts.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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	**PS1.A: Structure and Properties of Matter** • 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.	**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. **Energy and Matter** • The total amount of energy and matter in closed systems is conserved. -

describe the natural world operate today as they did in the past and will continue to do so in the future.

Using Mathematics and Computational Thinking

- Use mathematical representations of phenomena to support claims.

Engaging in Argument from Evidence

- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

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.

ESS3.A: Natural Resources

- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

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. *(secondary)*

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent.
- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

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Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Analysis of costs and benefits is a critical aspect of decisions about technology.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- How are ionic compounds formed? - How are the ionic compounds named? - What chemical compounds are found in our household items? - Why are some metals more expensive than others? - What happens to atoms during chemical reactions? - How can the properties of elements be used to design products? - How are amounts of a particular chemical measured in the lab?	- Name compounds and write their chemical formulas - Predict the results of single replacement reactions - Use the mole concept to quantify chemical measurements - Apply the law of conservation of mass to perform basic stoichiometric calculations - Synthesize the strengths and drawbacks of different materials to design a model coin, taking into account feasibility, creativity, and safety	• Naming Ionic Compounds using Legos Activity • Compounds in Household Items Lab • Mole Sample Lab • Physical & Chemical Changes Lab • Coin Project: Students will design a coin metal alloy that takes into account physical and chemical properties of the elements, the cost of mining, safety, and aesthetics • Law of Conservation of Mass Lab- Modeling Reactions with Fruit Loops • Activity Series Lab-Students will arrive at the construction of the activity series based on experimental results with various metals • Stoichiometry Lab (Gizmo) *Scientist Spotlight*: • Dorothy Crowfoot Hodgkin: x-ray	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of research, design, and presentation skills by building the project, including supporting documentation. - Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as

		crystallography and molecular structure. • **Bettye Washing Greene**: An industrial Chemist and Inventor who Lit a Path for Innovation.	the Unit Test.
Resources/Materials	- Naming Ionic Compounds using Legos Lab Kit - Compounds in Household Items Lab Kit - Mole Sample Lab Kit - Physical & Chemical Changes Lab Kit - Modeling Reactions- items like Fruit Loops or buttons, etc. - Activity Series Lab Kit - Explore Learning (subscription) Gizmos- Balancing Reactions, Stoichiometry		
ELA Companion Standards	**RST.9-10.7** 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. **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-12.7** 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.		
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. **SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. ***Mathematics*** **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities		
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions **9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. **9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** ● Act as a responsible and contributing community member and employee ● Consider the environmental, social, and economic impacts of decisions. ● Demonstrate creativity and innovation. ● Utilize critical thinking to make sense of problems and persevere in solving them. ● Use technology to enhance productivity, increase collaboration, and communicate effectively.		

	● Work productively in teams while using cultural/global competence.
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. **8.2.12.ED.5**: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

Modifications

Multi-Lingual Learners	Special Education	At-Risk	Gifted and Talented
● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner. ● Use sentence/paragraph frames to assist with writing peer review. ● Provide extended time for written responses and reports.	● Use scaffolds ● Provide extended time for written responses and reports. ● Use a graphic organizer to categorize concepts. ● Get a written list of instructions ● Receive large project as smaller tasks with individual deadlines ● Work or take a test in a different setting, such as a quiet room with few distractions ● Preferential seating ● Use an alarm to help with time management ● Work with a partner	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	● Name compounds involving transition metals ● Name covalent compounds ● Provide fewer scaffolds

Chemistry in the Community

Unit 4: Chemical Solutions

Time Allotted: 4 Weeks

New Jersey Student Learning Standards (NJSLS)

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

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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). **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.	**PS1.A: Structure and Properties of Matter** • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. **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. • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **PS3.A: Definitions of Energy** • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. *(secondary)*	**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. **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.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What makes the taste of beverages different? - What makes the strength of acids different? - How much sugar and caffeine are found in common beverages? - How can the rate of dissolving a solute be changed?	- Calculate concentration in terms of mg/mL or g/L - Distinguish between concentration (g/mL) of a solute and total solute concentration (g) - Evaluate the healthiness of beverages based on their sugar and caffeine content and concentration - Design and carry out a	- Design a Beverage Activity- Students will design the caffeine concentration and sugar concentration and use ratios to determine total amounts in a fictitious beverage of their own creation - Create a Beverage Lab- Students will create three different solutions (lemonade, iced tea etc) of varying concentrations - Rate of Dissolution Lab- students will write their own procedures to determine the factors (agitation, solvent concentration,	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of research, problem solving, and/or presentation skills by completing the project, including supporting documentation. - Assessment of skills such as

	procedure and analyze the results	temperature, surface area) that increase the rate at which a solute dissolves	Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test. - Chemistry Benchmark #2
Resources/Materials	- Create a Beverage Lab Materials (mix) - Sugar, Balances, Hot Plates, Beakers, Thermometers, Stirring Rods		
ELA Companion Standards	**RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account **WHST.9-12.7** 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. **WHST.11-12.8** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation		
Interdisciplinary Connections	***Mathematics*** **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities		
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. **9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** ● Act as a responsible and contributing community member and employee ● Demonstrate creativity and innovation. ● Utilize critical thinking to make sense of problems and persevere in solving them. ● Model integrity, ethical leadership, and effective management. ● Use technology to enhance productivity, increase collaboration, and communicate effectively. ● Work productively in teams while using cultural/global competence.		
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research,		

	constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. **8.2.12.ED.5**: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). **8.2.12.EC.3**: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience. **8.2.12.ETW.4**: Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints

Modifications

Multi-Lingual Learners	Special Education	At-Risk	Gifted and Talented
● Provide a word bank ● Provide extended time for written responses and reports. ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner. ● Use sentence/paragraph frames to assist with writing reports.	● Use scaffolds, such as prompting to assist with the design process and with the writing process. ● Provide extended time for written responses and reports. ● Use a graphic organizer to categorize concepts. ● Get a written list of instructions ● Receive large project as smaller tasks with individual deadlines ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management ● Work with a partner	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	● Take on additional variables or more trials to investigate in rate of dissolution lab to create a more robust procedure

Chemistry in the Community
Unit 5: Gases, Earth's Atmosphere & Weather and Radiation
Time Allotted: 6 Weeks
New Jersey Student Learning Standards (NJSLS)
HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. **HS-PS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. **HS-PS4-1** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. **HS-PS4-2** Evaluate questions about the advantages of using a digital transmission and storage of information **HS-PS4-3** Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other **HS-PS4-4** Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter **HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. **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 impacts.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Developing and Using Models • Use a model to provide mechanistic accounts of phenomena. **Obtaining, Evaluating, and Communicating Information** • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. **Using Mathematics and Computational Thinking** • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.	**PS3.D: Energy in Chemical Processes** • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. *(secondary)* **PS4.A: Wave Properties** • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. • The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. • [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) **PS4.B: Electromagnetic Radiation** • Photoelectric materials emit electrons when they absorb light of a high-enough frequency. • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Systems can be designed to cause a desired effect. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. **Stability and Change** • Systems can be designed for greater or lesser stability. **Systems and System Models** • Models (e.g., physical, mathematical, computer

Asking Questions and Defining Problems
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

Engaging in Argument from Evidence
- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.

PS4.C: Information Technologies and Instrumentation
- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.

ESS1.B: Earth and the Solar System
- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. *(secondary)*

ESS2.A: Earth Materials and Systems
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.

ESS2.D: Weather and Climate
- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.

models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Science and engineering complement each other in the cycle known as research and development (R&D).

Influence of Engineering, Technology, and Science on Society and the Natural World
- Modern civilization depends on major technological systems.
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- What is the nature of air? Does it have mass? What happens when air is removed? - Can footballs actually lose pressure	- Apply computational thinking to by using the gas laws and performing unit conversions - Model the gas laws using graphs	- Bell Jar Lab- Students will evacuate a bell jar using a pump system to show that mass has air, and that molecular motion creates pressure	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by

with lower temperatures? If so, by what amount? - How can engineers successfully prepare an effective and safe airbag? - What is Earth's atmosphere composed of? - How do devices transmit information using radiation?	and interpolation - Design a model airbag using the ideal gas law - Describe the structure of Earth's atmosphere - Describe the regions of the electromagnetic spectrum using frequency and wavelength	- Gas Law Stations Lab- students will investigate how pressure, volume, and temperature interact in everyday phenomena, such as air expanding in warm temperatures and the impacts climate change has on this phenomenon. - Is Tom Brady a Cheater?-Students will apply the relevant gas laws to determine how much a temperature drop can affect pressure - Graphing the Gas Laws Lab-Students will collect data to produce graphs as models of the gas laws - Online Gas Law Simulator Activity - Uses of Electromagnetic Radiation in Technology Project-Students will investigate a form of technology that uses electromagnetic radiation to send and receive data - Project: Design a model of an airbag *Scientist Spotlight*: • **Eunice Foot** – amateur scientists from the mid-1800s whose experiments foreshadowed the discovery of Earth's Greenhouse effect.	submitting Lab Reports for each lab conducted - Assessment of research, problem solving, and/or presentation skills by completing the project, including supporting documentation. - Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.
Resources/Materials	- Bell Jar Lab Kit (Bell Jar Lab) - Balances - Gas Law Station Lab Kit - Pasco Pressure Sensor (Graphing the Gas Laws Lab) - https://www.grc.nasa.gov/WWW/K-12/airplane/Animation/frglab.html - Microsoft Excel (to produce graphs) - https://scied.ucar.edu/atmosphere-layers - Ramps, Low Friction Car, Eggs, Vinegar, Baking Soda for Airbag Lab		
ELA Companion Standards	**RST.9-10.8** Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem **RST.11-12.1** Write arguments focused on discipline-specific content **RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem **RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information		

	WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes **WHST.11-12.8** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. **SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source. **SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence. **SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. ***Mathematics*** **MP.2** Reason abstractly and quantitatively **MP.4** Model with mathematics **HSA-SSE.A.1** Interpret expressions that represent a quantity in terms of its context **HSA-SSE.B.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. **HSA.CED.A.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. **9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** ● Act as a responsible and contributing community member and employee ● Consider the environmental, social, and economic impacts of decisions. ● Demonstrate creativity and innovation. ● Utilize critical thinking to make sense of problems and persevere in solving them. ● Model integrity, ethical leadership, and effective management. ● Use technology to enhance productivity, increase collaboration, and communicate effectively.

	● Work productively in teams while using cultural/global competence.
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. **8.2.12.ED.5**: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). **8.2.12.EC.3**: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience. **8.2.12.ETW.4**: Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints **8.2.12.NT.1**: Explain how different groups can contribute to the overall design of a product. **8.2.12.NT.2**: Redesign an existing product to improve form or function

Modifications

Multi-Lingual Learners	Special Education	At-Risk	Gifted and Talented
● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provie word banks ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner. ● Provide extended time for written responses and reports.	● Provide additional time for project development. ● Preferential Seating ● Work with a peer ● Provide word banks ● Utilize graphics to support learning. ● Supplemental material posted on Canvas ● Provide written list of instructions ● Break down large project as smaller tasks with individual deadlines ● Use an alarm to help with time management	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	● Provide fewer scaffolds in labs and in Tom Brady DeflateGate Activity ● Perform more design iterations in the airbag lab

Chemistry in the Community

Unit 6: Petroleum and Climate Change Chemistry

Time Allotted: 4 Weeks

New Jersey Student Learning Standards (NJSLS)

HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity
HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios
HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity
HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Developing and Using Models • Use a model to provide mechanistic accounts of phenomena. **Constructing Explanations and Designing Solutions** • Construct 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. **Engaging in Argument from Evidence** • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). **Using Mathematics and Computational Thinking** • Create a computational model or simulation of a phenomenon, designed device, process, or system. • Use a computational representation of phenomena or design solutions to	**ESS1.B: Earth and the Solar System** • Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. *(secondary)* **ESS2.A: Earth Materials and Systems** • The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. **ESS2.D: Weather and Climate** • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. • Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. *(secondary)*	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Stability and Change** • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. **Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. - *Connections to Engineering, Technology, and Applications of Science* **Influence of Science, Engineering, and Technology on Society and the Natural World** • Modern civilization depends on major technological systems. • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

describe and/or support claims and/or explanations.

Analyzing and Interpreting Data

- Analyze data using computational models in order to make valid and reliable scientific claims.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.
- Science knowledge is based on empirical evidence.

Scientific Investigations Use a Variety of Methods

- Science investigations use diverse methods and do not always use the same set of procedures to obtain data.
- New technologies advance scientific knowledge.

ESS3.A: Natural Resources

- Resource availability has guided the development of human society.
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.

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. *(secondary)*

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

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
- Many decisions are not made using science alone but rely on social and cultural contexts to resolve issues.

Science is a Human Endeavor

- Science is a result of human endeavors, imagination, and creativity.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- Why is crude oil so valuable? - How do human activities impact Earth's systems? - What are the consequences of climate change?	- Represent molecules using Lewis Dot Structures - Predict properties of molecules based on their polarity/nonpolarity - Describe the burning of components of crude oil and its effects on climate change - Describe the major indicators of climate change - Evaluate evidence about the Earth's changing climate	- Molecular Models Lab - M&M Pigment Dissolving Lab - "Making Scents" Activity - Alkane Isomers Lab - Acid Rain Lab- students will investigate the effects of rain acidification (resulting from human activity) on various materials - Climate Change Presentation/Debate: Students will perform research about climate	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of research, argumentation, and/or presentation skills by completing the project, including supporting documentation. - Assessment of skills such as

	- Describe the ramifications of climate change - Carry out an investigation to demonstrate the destructiveness of rain acidifications	change. They will evaluate information and use it to defend a position and engage in debate with their classmates. Students must use high quality sources (ie subscription databases) and cite all sources meticulously. Students must readily provide sources for all claims made in debate. *Scientist Spotlight*: • **Winifred Burks-Houck**: An environmental organic chemist and the first woman president of the National Organization for the Professional Advancement of Black Chemists and chemical Engineers. • **Warren Washington** – atmospheric climate scientist	Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.

Resources/Materials	- Molecular Models Kit
	- M&M Lab Kit
	- Acid Rain Lab Kit
	- Online Subscription-based Databases for Research
	- Climate Change NASA Resources:
	  - http://www.youtube.com/watch?v=fv11W5OODeM)
	  - http://www.youtube.com/watch?v=VEuEqgdJXHg
	  - http://climate.nasa.gov/evidence
	  - http://climate.nasa.gov/causes		

ELA Companion Standards	**RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. **RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.		
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.		

	SL.9-10.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source. **SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence. **SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. ***Mathematics*** **MP.2** Reason abstractly and quantitatively. **HSN-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. **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving **9.4.12.CT.3**: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions **9.4.12.IML.6**: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity **9.4.12.IML.7**: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change **9.4.12.GCA.1**: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others **9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. **9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest. **9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** ● Act as a responsible and contributing community member and employee ● Consider the environmental, social, and economic impacts of decisions. ● Demonstrate creativity and innovation. ● Utilize critical thinking to make sense of problems and persevere in solving them. ● Model integrity, ethical leadership, and effective management. ● Use technology to enhance productivity, increase collaboration, and communicate effectively.

	● Work productively in teams while using cultural/global competence.
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. **8.2.12.ED.5**: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). **8.2.12.EC.3**: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience. **8.2.12.ETW.4**: Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints **8.2.12.NT.1**: Explain how different groups can contribute to the overall design of a product.

Modifications

Multi-Lingual Learners	Special Education	At-Risk	Gifted and Talented
● When possible, modify assignments so the ELL student writes less, has simpler questions to answer, fewer spelling words, etc. ● Provie word banks ● Provide models of completed homework assignments, projects, etc. ● Assign a native language partner ● Provide extended time for written responses and reports ● Provide the option of doing a presentation instead of a debate for the performance assessment	● Provide additional time ● Preferential Seating ● Work with a peer ● Provide word banks ● Utilize graphics to support learning. ● Supplemental material posted on Canvas ● Provide written list of instructions ● Break down large project as smaller tasks with individual deadlines ● Use an alarm to help with time management	● Use a graphic organizer to categorize concepts. ● Provide an outline for research and design tasks. ● Provide extended time for written responses and reports. ● Incorporate student choice ● Provide peer mentoring to improve techniques ● Use effort and achievement rubrics ● Assure students they can be successful ● Promote mastery or challenging tasks ● Allow students many opportunities for practice and learning ● Use scaffolding for complex tasks ● Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	● Include more variables and/or trials in the acid rain lab ● Provide a more nuanced debate prompt for the debate performance assessment ● Provide less scaffolding in alkane isomer lab or have students create more isomers

Chemistry in the Community

Unit 7: Nuclear Chemistry

Time Allotted: 2 Weeks

New Jersey Student Learning Standards (NJSLS)

HS-PS-1-8: Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	**PS1.C: Nuclear Processes** • Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.	**Energy and Matter** • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- Are we exposed to radiation in our daily lives? If so, how? - How does a nuclear power work? - What are the pros and cons of using nuclear power? - What nuclear incidents have occurred? Do the benefits of nuclear power outweigh the dangers?	- Write nuclear equations - Perform Half Life Calculations - Evaluate pros and cons of nuclear power	- Half Life Lab: students will model the nuclear decay of a radioactive isotope using pennies and quantify the decay - "Eyes of Nye" Video - Radiation Exposure Survey - Nuclear Decay ExploreLearning Gizmo - Performance Assessment: Nuclear Disaster- Students will deliver a presentation that describes a nuclear meltdown *Scientist Spotlights:* • **Lloyd Albert Quarterman** – African American Chemist who worked on the Manhattan Project • **Lise Meinter** – Jewish, female scientist who discovered nuclear fission. • **Katherine Way** – American, female scientist who worked on the Manhattan Project & established the Nuclear Data Project. • **Marie Curie** – Female scientist who discovered radium and polonium & made	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of research, problem solving, and/or presentation skills by completing the project, including supporting documentation. - Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test. - Chemistry Benchmark #3

		major contributions towards finding treatments for cancer.	
Resources/Materials	- Half Life Lab Kit - Explore Learning Gizmo - Nuclear Decay - https://www.youtube.com/watch?v=aDdPk0-SDmI - https://www.epa.gov/radiation/calculate-your-radiation-dose		
ELA Companion Standards	**RST.9-10.7** 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 **WHST.9-12.5** 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. **WHST.9-12.7** 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. **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research.		
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. **SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source. **SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence. **SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. **SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. ***Mathematics*** **MP.2** Reason abstractly and quantitatively **MP.4** Model with mathematics **HSN-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. **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling.		
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	9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. **Career Readiness, Life Literacies, and Key Skills Practices** ● Act as a responsible and contributing community member and employee ● Consider the environmental, social, and economic impacts of decisions. ● Demonstrate creativity and innovation. ● Utilize critical thinking to make sense of problems and persevere in solving them. ● Model integrity, ethical leadership, and effective management. ● Use technology to enhance productivity, increase collaboration, and communicate effectively. ● Work productively in teams while using cultural/global competence.
Computer Science and Design Thinking	**8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. **8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers. **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. **8.2.12.ED.5**: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). **8.2.12.EC.3**: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience. **8.2.12.ETW.4**: Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints **8.2.12.NT.1**: Explain how different groups can contribute to the overall design of a product.

Modifications

Multi-Lingual Learners	Special Education	At-Risk	Gifted and Talented
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		• Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	

Chemistry in the Community
Unit 8: Food and Medicine
Time Allotted: 4 Weeks
New Jersey Student Learning Standards (NJSLS)
HS-PS1-4. 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-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-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. **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 (second law of thermodynamics). **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.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or between components of a system. **Using Mathematics and Computational Thinking** • Create a computational model or simulation of a phenomenon, designed device, process, or system. **Constructing Explanations and Designing Solutions** • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	**PS1.A: Structure and Properties of Matter** • A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. **PS1.B: Chemical Reactions** • Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. • In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. **PS3.A: Definitions of Energy** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. **Systems and System Models** • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. **Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
- Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

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.

PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.
- The availability of energy limits what can occur in any system.
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.

ETS1.A: Defining and Delimiting an Engineering Problem

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. *(secondary)*

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary)*

causality in explanations of phenomena.

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable.

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent.

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering and Technology on Society and the Natural World

- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
- How can we determine the number of calories in a Dorito? - How can we make medicines work more quickly? - What household items are acids and bases, and what are their pH levels? - How does the fat, carbohydrate, and protein content of food impact its calorie content?	- Apply computational thinking to relate H+ concentration to acids and bases on the pH Scale - Predict and determine the quantity of energy that a sample contains using calorimetry - Compare results of calorimetry calculations to food calories calculations using the “4-4-9” rule - Apply concepts of caloric content to real life decision making	• Calories in a Snack Activity • Dorito Burning Lab • pH of Household Substances Lab • BMR Calculation Activity • Eat This Not That Project • Performance Assessment: Rate of Reaction Alka Seltzer Lab Scientist Spotlight: • **Dorothy Crowfoot Hodgkin**: Discovered	- Assessment of lab skills (Experimental Design, Data Analysis, and/or Arguing a Scientific Claim) by submitting Lab Reports for each lab conducted - Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking

		the molecular structure of penicillin • **Dr. Carolyn Bertozzi** - She is the inventor of "bioorthogonal chemistry", a class of chemical reactions compatible with living systems that enable molecular imaging and drug targeting • **Lloyd Augustus Hall** – Used chemistry to invent a number of different ways to preserve food.	quizzes as well as the Unit Test.
Resources/Materials	- Dorito Burning Lab Kit - Scales, Thermometers, Hot Plates, Alka Seltzer - Explore Learning pH Indicator Acids & Bases Gizmo		
ELA Companion Standards	**RST.9-10.7** 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 **RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account **WHST.11-12.8** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research.		
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• Provide extended time for written responses and reports • Provide the option of doing a presentation instead of a debate for the performance assessment	• Break down large project as smaller tasks with individual deadlines • Use an alarm to help with time management	• Assure students they can be successful • Promote mastery or challenging tasks • Allow students many opportunities for practice and learning • Use scaffolding for complex tasks • Evaluate students on the basis of mastery and not one another. Classroom activities should be noncompetitive	

Additional Resources to promote DEI:

- Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity
- Race Matters
- Inclusive Teaching