Lakewood School DIstrict Curriculum Guide

Grade: High School	**Content Area: Science - Integrated**

Original Adoption: 2023 NJSLS English Language Arts and English as a Second Language (8-21-24); Math NJSLS Mathematics (8-21-24); 2020 NJSLS Science, Social Studies, Career Readiness, Life Literacies & Key Skills, Computer Design & Thinking, Visual & Performing Arts, World Language, Comprehensive Health and Physical Education (5-11-22)
Created By:

Recommended Pacing Guide	
Unit 1: Motion and Forces	35 days
Unit 2: Energy	35 days
Unit 3: Waves	35 days
Unit 4: Matter	35 days
Unit 5: Reactions	35 days

Alignment with State Mandates

The following colors are used throughout this document to indicate areas in which the curriculum is aligned with the following NJSA requirements:

- Holocaust and genocides (N.J.S.A. 18A:35-28)
- History and contributions of African-Americans (Amistad Law) (N.J.S.A. 18A:35-4.43)
- Highlight and promote diversity and inclusion (Diversity & Inclusion Law) (N.J.S.A. 18A:35-4.36a)
- History of disabled and LGBT persons included in middle and high school curriculum (Section 18A:35-4.35)
- Climate Change - to prepare students to understand how and why climate change happens, the impact it has on our local and global communities and to act in informed and sustainable ways. Please click here for specific examples (by subject).

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Unit 1: Motion and Forces	Unit 1: Motion and Forces

New Jersey Learning Standards-Science

HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
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 and Engineering Practices	Discipline Core Ideas/Unit Enduring Understandings	Crosscutting Concepts
Analyzing and Interpreting Data ● · Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1) **Using Mathematics and Computational Thinking** ● · Use mathematical representations of phenomena to describe explanations. (HS-PS2-2) ● Constructing Explanations and Designing Solutions ● · Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HSPS2-3) ● · Design a solution to a complex real world problem, based on scientific knowledge,	**PS2.A: Forces and Motion** ● · Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) ● · Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2) ● · If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2) **ETS1.A: Defining and Delimiting Engineering Problems** ● · 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	**Cause and Effect** ● · Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS21) ● · Systems can be designed to cause a desired effect. (HS-PS2-3) **Systems and System Models** ● · When investigating or describing a system, the boundaries and initial conditions of the system needs to be defined. (HS-PS2-2) **Connections to Engineering, Technology, and Applications of Science** ● Influence of Science, Engineering, and Technology on Society and the Natural World ● · New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-3) **Connections to Nature of Science** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**

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student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2) ● · Evaluate a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)	meets them. (secondary to HS-PS23) **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 (tradeoffs) may be needed. (secondary to (HS-PS2-3) **ETS1.B: Developing Possible Solutions** ● · When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)	● · Theories and laws provide explanations in science. (HS-PS2-1) ● · Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1)

Social and Emotional Learning Standards	
Self-Awareness	● Recognize one's personal traits, strengths, and limitations ● Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	● Recognize the skills needed to establish and achieve personal and educational goals ● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	● Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	● Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA 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.
● **W.WR.11–12.5**	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.
● **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.
● **SL.AS.11–12.6**	Adapt speech to a variety of contexts and tasks, demonstrating a command of formal

	English when indicated or appropriate.
• **RL.CR.11–12.1**	Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.
• **SL.PE.11–12.1**	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
	Math Standards
• **HSA.SSE.A.1**	Interpret expressions that represent a quantity in terms of its context.
• **HSA.CED.A.1**	Create equations and inequalities in one variable and use them to solve problems.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.2 Design Thinking

- 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.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
- 8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.12.EG.3: Explain how individuals and businesses influence government policies

9.2 Career Readiness, Life Literacies, and Key Skills

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.3 Career & Technical Education (CTE)

- 9.3.12.AG-PST.1: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
- 9.3.12.AC-DES.1: Justify design solutions through the use of research documentation and analysis of data.
- 9.3.ST-ET.1: Use STEM concepts and processes to solve problems involving design and/or production.
- 9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects
- that address real world problems.

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- 9.3.12.AG-ENV.3: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- 9.3.GV-SEC.5: Develop strategies to defend against and respond to the effects of chemical, biological, radiological, nuclear (CBRN) or other emergent events.

9.4 Life Literacies & Key Skills

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Evidence of Student Learning

Formative Tasks:

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

Alternative Assessments:

- Teacher-Created Projects
- https://www.khanacademy.org/
- Completion of webquests
- On-Line Laboratory activities
- Online assessment activities example:
  - Kahoot
  - Quizizz

Summative Assessments:

- Unit Tests
- Midterm Exam
- Final Exam

Benchmark Assessments:

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Motion is governed by predictable mathematical relationships among force, mass, and acceleration, as described by Newton's second law.
- Changes in an object's motion result from net forces acting on the object rather than from motion alone.
- Momentum is conserved within a closed system when no external net force acts on the system.

Essential Questions:

- How do force, mass, and acceleration interact to determine how an object's motion changes?
- Why does an object's motion change only when a net force acts on it?
- How is momentum used to explain the behavior of interacting objects in a closed system?
  How can collisions be analyzed and designed to reduce the forces experienced by objects?
- In what ways can increasing collision time reduce the impact force during an interaction?
  How can complex real-world problems be broken

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● Analyzing data and using mathematical models strengthens claims about motion, force, and momentum in physical systems. ● The forces experienced during collisions can be reduced by extending the time over which momentum changes occur. ● Engineering design applies physical principles to create devices that minimize harmful forces in real-world situations. ● Complex problems can be addressed effectively by breaking them into smaller, solvable components that align with scientific and engineering concepts. ● Evaluating engineering solutions requires balancing performance with constraints such as safety, cost, reliability, and social or environmental impact.	into smaller components to support effective engineering solutions? What criteria and constraints should be prioritized when evaluating engineering designs for safety and performance?
Content *Students will know…* ● Theories and laws provide explanations in science. ● Laws are statements or descriptions of the relationships among observable phenomena. ● Empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. ● Newton's second law accurately predicts changes in the motion of macroscopic objects. ● Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. ● If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. ● If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. ● Criteria and constraints also include satisfying	**Skills** *Students will be able to …* ● Analyze data using tools, technologies, and/or models to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. ● Analyze data using one-dimensional motion at nonrelativistic speeds to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. ● Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. ● Use mathematical representations of the quantitative conservation of momentum and the qualitative meaning of this principle in systems of two macroscopic bodies moving in one dimension. ● Describe the boundaries and initial conditions of a system of two macroscopic bodies moving in one dimension. ● Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. ● Apply scientific ideas to solve a design problem for a device that minimizes the force on a macroscopic object during a collision, taking into account possible

any requirements set by society, such as taking issues of risk mitigation into account, and the criteria and constraints should be quantified to the extent possible and stated in such a way that one can determine whether a given design meets them. ● 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. ● 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. ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. ● Systems can be designed to cause a desired effect.	unanticipated effects. ● Use qualitative evaluations and /or algebraic manipulations to design and refine a device that minimizes the force on a macroscopic object during a collision.

Core Instructional & Supplemental Materials	
Suggested Activities/Resources: ● Labs: ○ Red Bull Space Jump ○ Feather and Bowling Ball dropping ○ Atwoods Machine Interactions ○ Elevator Ride ○ Kite Flying ○ Was Galileo Right? ○ Momentum Thinking Problem ○ Relating Formulas to Common Sense ○ Collision Lab ○ Egg Dropping in Free fall ○ How do objects become positive or negative? ○ Carousel	**Supplemental resources:** ● https://njctl.org/courses/science/ap-physics-1/ ● https://ngss.nsta.org/Resource.aspx?ResourceID=892 ● https://ngss.nsta.org/Resource.aspx?ResourceID=857 ● https://www.physicsclassroom.com/Physics-Interactives/Newtons-Laws/Atwoods-Machine/Atwoods-Machine-Interactive ● https://www.physicsclassroom.com/Physics-Interactives/Newtons-Laws/Elevator-Ride ● https://blossoms.mit.edu/videos/lessons/kite_flying_fun_art_and_science ● https://learn.concord.org/resources/146/was-galileo-right ● https://njctl.org/courses/science/ap-physics-1/ ● http://www.physics.umd.edu/perg/abp/think/mech/mechme.htm ● http://umdperg.pbworks.com/w/page/10511239/Tutorials%20in%20Physics%20Sense-Making ● http://umdperg.pbworks.com/w/page/10511239/ut

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	orials%20in%20Physics%20Sense-Making • https://njctl.org/courses/science/ap-physics-1/ • https://betterlesson.com/next_gen_science/browse/2279/ngss-hs-ps2-3-apply-scientific-and-engineering-ideas-to-design-evaluate-and-refine-a-device-that-minimizes-the-force-on-a-macros • Race & Social Justice Teacher Resources • Motion and Forces

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives

- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

504 Plans:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

Gifted and Talented:

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

Students at Risk of Failure:

- Extended Time
- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning

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- Tiered Activities
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

Unit 2: Energy	35 days
New Jersey Learning Standards-Science	
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.

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HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
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-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Science and Engineering Practices	Discipline Core Ideas/Unit Enduring Understandings	Crosscutting Concepts
Developing and Using Models · Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2) **Using Mathematics and Computational Thinking** · Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1) · Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4) **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,	**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. (HS-PS3-2) · At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) · These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate	**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. (HS-PS3-1) · Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-4) **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. (HS-PS3-3) · Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2) **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

and tradeoff considerations. (HS-PS3-3) **Asking Questions and Defining Problems** · Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1) **Constructing Explanations and Designing Solutions** · Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2) · Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)	interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) **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. (HS-PS3-1) · Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1) · 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. (HS-PS3-1) · The availability of energy limits what can occur in any system. (HS-PS3-1) **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. (HS-PS3-3) **ETS1.A: Defining and Delimiting an Engineering Problem** · Criteria and constraints also include satisfying any requirements set by society,	technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS3-3) · New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3) **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. (HS-PS3-1)

	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 to HS-PS3-3) **ETS1.A: Defining and Delimiting Engineering Problems** · 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. (HS-ETS1-1) · Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1) **ETS1.B: Developing Possible Solutions** · When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) · Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and	

	in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4) **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. (HS-ETS1-2)	

Social and Emotional Learning Standards	
Self-Awareness	● Recognize one's personal traits, strengths, and limitations ● Recognize the importance of self-confidence in handling daily tasks and challenges
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Social Awareness	● Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	● Develop, implement and model effective problem solving and critical thinking skills

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● **SL.PE.11–12.1**	Come to discussions prepared, having read and researched material under study; explicitly

	draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
	Math Standards
• **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.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.2 Design Thinking

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- 8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
- 8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.12.EG.3: Explain how individuals and businesses influence government policies

9.2 Career Readiness, Life Literacies, and Key Skills

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.3 Career & Technical Education (CTE)

- 9.3.12.AG-PST.1: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
- 9.3.12.AC-DES.1: Justify design solutions through the use of research documentation and analysis of data.
- 9.3.ST-ET.1: Use STEM concepts and processes to solve problems involving design and/or production.
- 9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects
- that address real world problems.
- 9.3.12.AG-ENV.3: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- 9.3.GV-SEC.5: Develop strategies to defend against and respond to the effects of chemical, biological, radiological, nuclear (CBRN) or other emergent events.

Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Science - Integrated

9.4 Life Literacies & Key Skills

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Evidence of Student Learning

Formative Tasks:

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

Alternative Assessments:

- Teacher-Created Projects
- https://www.khanacademy.org/
- Completion of webquests
- On-Line Laboratory activities
- Online assessment activities example:
  - Kahoot
  - Quizizz

Summative Assessments:

- Unit Tests
- Midterm Exam
- Final Exam

Benchmark Assessments:

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Energy in a system can be tracked, calculated, and modeled to explain changes in system components over time.
- Energy is conserved as it flows into, out of, and within systems, even though it may change form. Macroscopic energy phenomena can be explained by the motion and relative position of particles and objects.
- Computational and mathematical models are essential tools for analyzing complex energy systems and predicting outcomes.
- Energy transformations are constrained by system design, materials, and environmental conditions.

Essential Questions:

- How can energy changes within a system be modeled and calculated using known energy flows?
- In what ways do particle motion and position explain observable energy behavior at the macroscopic scale?
  How does energy change form while remaining conserved within a system?
  How can computational models improve predictions about energy transfer and system performance?
- What design features influence how efficiently a device converts one form of energy into another?
- How do criteria and constraints shape engineering solutions to global energy-related challenges?

Grade: High School	**Content Area: Science - Integrated**

• Effective engineering solutions require identifying clear criteria and constraints that reflect real-world needs and limitations. • Complex global challenges can be addressed by breaking problems into smaller components and testing solutions iteratively. • Evaluating and refining solutions involves balancing efficiency, feasibility, and societal, environmental, and ethical impacts.	• Why is it important to break complex problems into smaller, manageable engineering tasks? • How do trade-offs among efficiency, cost, safety, and environmental impact influence final design decisions?
Content *Students will know…* • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). • In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). • Radiation is a phenomenon in which energy stored in fields moves across spaces. • Energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. • 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. • 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.	**Skills** *Students will be able to …* • Develop and use models based on evidence to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with motions of particles (objects) and energy associated with the relative position of particles (objects). • Develop and use models based on evidence to illustrate that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. • Use mathematical expressions to quantify how the stored energy in a system depends on its configuration (e.g., relative positions of charged particles, compressions of a spring) and how kinetic energy depends on mass and speed. • Use mathematical expressions and the concept of conservation of energy to predict and describe system behavior. • Use basic algebraic expressions or computations to create a computational model to calculate the change in the energy of one component in a system (limited to two or three components) when the change in energy of the other component(s) and energy flows in and out of the system are known. • Explain the meaning of mathematical expressions used to model the change in the energy of one component in a system (limited to two or three components) when the change in energy of the other component(s) and out of the system are known. • Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. • Analyze a device to convert one form of energy into another form of energy by specifying criteria and constraints for successful solutions.

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● The availability of energy limits what can occur in any system. ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximation inherent in models. ● Science assumes that the universe is a vast single system in which basic laws are consistent. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● Although energy cannot be destroyed, it can be converted to less useful forms, for example, to thermal energy in the surrounding environment. ● 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. ● 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. ● News technologies can have deep impacts on society and the environment, including some that were not anticipated. ● Analysis of costs and benefits is a critical aspect of decisions about technology. ● 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. ● Humanity faces major global challenges today, such as the need for supplies of clean water or for energy sources that minimize pollution that can be addressed through engineering. These global challenges also may have manifestations in local communities.	● Use mathematical models and/or computer simulations to predict the effects of a device that converts one form of energy into another form of energy.

Core Instructional & Supplemental Materials

Grade: High School	Content Area: Science - Integrated

Suggested Activities/Resources:

- Lab:
  - 50 Foot Solar Balloon
  - Chart that Motion
  - Kinetic Energy Converting to Thermal Energy
  - Work and Energy Thinking Problems
  - The Power of Oreos
  - The Springy Pen Lab
  - Hot Wheels Stopping Distance
  - Wrecking Ball Science
  - Energy Flow
  - Solar Water Heater
  - Concentrated Solar Power
  - Photovoltaic Cell

Supplemental resources:

- https://njctl.org/courses/science/ap-physics-1/
- https://www.youtube.com/watch?v=m8wB0O-5IzY
- https://www.physicsclassroom.com/NGSS-Corner/Activity-Descriptions/Chart-That-Motion-Description
- https://www.youtube.com/watch?v=6qSrAKesp90
- https://ngss.nsta.org/Resource.aspx?ResourceID=305
- http://172.29.2.25/index.asp
- https://betterlesson.com/lesson/634088/the-springy-pen-lab
- https://www.physicsclassroom.com/getattachment/reasoning/energy/src14.pdf
- https://www.youtube.com/watch?v=09x_UZ-BtF8
- https://www.youtube.com/watch?v=09x_UZ-BtF8
- https://www.teachengineering.org/activities/view/cub_housing_lesson01_activity1
- https://www.teachengineering.org/lessons/view/cub_pveff_lesson04
- http://www.ccmr.cornell.edu/wp-content/uploads/sites/2/2015/11/PhotovoltaicCells.pdf
- Race & Social Justice Teacher Resources

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided

- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

504 Plans:

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- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

Gifted and Talented:

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project

- Interest Based/Choice Activities

Students at Risk of Failure:

- Extended Time
- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
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- Chunking Information
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- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

Grade: High School	Content Area: Science - Integrated

Unit 3: Waves	35 days

New Jersey Learning Standards-Science

HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Science and Engineering Practices	Discipline Core Ideas/Unit Enduring Understandings	Crosscutting Concepts
Using Mathematics and Computational Thinking · Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)	**PS4.A: Wave Properties** · 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. (HS-PS4-1)	**Cause and Effect** · Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)

Social and Emotional Learning Standards	
Self-Awareness	● Recognize one's personal traits, strengths, and limitations ● Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	● Recognize the skills needed to establish and achieve personal and educational goals ● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	● Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	● Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA 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.
● **W.WR.11–12.5**	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.
● **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.

Grade: High School	Content Area: Science - Integrated

• **SL.AS.11–12.6**	Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.
• **RL.CR.11–12.1**	Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.
• **SL.PE.11–12.1**	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
	Math Standards
• **MP.2**	Reason abstractly and quantitatively
• **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.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.2 Design Thinking

- 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.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
- 8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.12.EG.3: Explain how individuals and businesses influence government policies

9.2 Career Readiness, Life Literacies, and Key Skills

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.3 Career & Technical Education (CTE)

- 9.3.12.AG-PST.1: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

Grade: High School	**Content Area: Science - Integrated**

- 9.3.12.AC-DES.1: Justify design solutions through the use of research documentation and analysis of data.
- 9.3.ST-ET.1: Use STEM concepts and processes to solve problems involving design and/or production.
- 9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects
- that address real world problems.
- 9.3.12.AG-ENV.3: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- 9.3.GV-SEC.5: Develop strategies to defend against and respond to the effects of chemical, biological, radiological, nuclear (CBRN) or other emergent events.

9.4 Life Literacies & Key Skills

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Evidence of Student Learning	
Formative Tasks: ● Oral Questioning ● Student Conference ● Self-Assessment ● Hand Signals ● Communicators ● Graphic Organizers ● Teacher Observation ● DOL ● Quiz Classwork ● NJSLA Released questions ● Problem of the Day	**Alternative Assessments:** ● Teacher-Created Projects ● https://www.khanacademy.org/ ● Completion of webquests ● On-Line Laboratory activities ● Online assessment activities example: ○ Kahoot ○ Quizizz
Summative Assessments: ● Unit Tests ● Midterm Exam ● Final Exam	**Benchmark Assessments:** ● Quarterly Benchmarks ● Beginning/End of Year Assessment ● Unit Common Assessment

Knowledge & Skills	
Enduring Understandings: ● Waves transfer energy through space or matter without transferring mass. ● The speed of a wave depends on the properties of the medium through which it travels.	**Essential Questions:** ● How are frequency, wavelength, and wave speed related mathematically? ● Why does wave speed change when a wave travels through different media? ● How does changing frequency affect wavelength when wave speed is constant?

Grade: High School	**Content Area: Science - Integrated**

• Frequency, wavelength, and wave speed are mathematically related and can be used to predict wave behavior. • Changes in one wave property result in predictable changes in the others when the medium remains constant. • Mathematical representations provide evidence to support claims about wave relationships. • Graphs, equations, and data tables help describe and compare wave motion across different media. • Wave models allow scientists to explain and predict real-world phenomena such as sound, light, and water waves. • Quantitative reasoning strengthens scientific explanations of wave interactions and propagation.	• How can mathematical models be used to support claims about wave behavior? • What information do graphs and equations reveal about wave motion? • How can wave properties be measured and compared across different media? • How do wave models help explain everyday phenomena involving sound and light? • Why is quantitative evidence essential for understanding and explaining wave relationships?
Content *Students will know…* • The wavelength and frequency of a wave is 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. • Empirical evidence is required to differentiate between cause and correlation and to make a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	**Skills** *Students will be able to …* • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. • Use algebraic relationships to quantitatively describe relationships among the frequency, wavelength, and speed of waves traveling in various media

Core Instructional & Supplemental Materials	

Suggested Activities/Resources:
• Lab:
  ○ Physics
  ○ Wave length
	Supplemental resources:
	• https://njctl.org/courses/science/ap-physics-1/
	• https://betterlesson.com/next_gen_science/browse/2290/ngss-hs-ps4-1-use-mathematical-representations-to-support-a-claim-regarding-relationships-among-the-frequency-wavelength-and-spe

Suggested Accommodations
English Language Learners: • Multi-Sensory Instruction

- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
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- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

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- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts

Grade: High School	Content Area: Science - Integrated

- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

Unit 4: Matter	35 days

New Jersey Learning Standards-Science

HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
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-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
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Science and Engineering Practices	Discipline Core Ideas/Unit Enduring Understandings	Crosscutting Concepts
Developing and Using Models ● Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)	**PS1.A: Structure and Properties of Matter** Each atom has a charged substructure consisting of a nucleus, which is made of	**Patterns** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3)

Grade: High School	Content Area: Science - Integrated

Planning and Carrying Out Investigations Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3) **Constructing Explanations and Designing Solutions** ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) ● Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3) **Obtaining, Evaluating, and Communicating Information** ● Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	protons and neutrons, surrounded by electrons. (HS-PS1-1) ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6) **PS1.B: Chemical Reactions** ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2) **PS2.B: Types of Interactions** ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary to HS-PS1-1),(secondary to HS-PS1-3) **ESS2.D: Weather and Climate** ● Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6) **ETS1.B: Developing Possible Solutions**	**Structure and Function** ● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6) **Systems and System Models** ● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-4) **Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World** ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3)

Grade: High School	Content Area: Science - Integrated

(HS-PS2-6) **Using Mathematics and Computational Thinking** ● Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)	● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) ● Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)	

Social and Emotional Learning Standards	
Self-Awareness	● Recognize one's personal traits, strengths, and limitations ● Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	● Recognize the skills needed to establish and achieve personal and educational goals ● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	● Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	● Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA 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.
● **W.WR.11–12.5**	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.
● **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.

Grade: High School	Content Area: Science - Integrated

• **SL.AS.11–12.6**	Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.
• **RL.CR.11–12.1**	Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.
• **SL.PE.11–12.1**	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
	Math Standards
• **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.
• **MP.2**	Reason abstractly and quantitatively.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.2 Design Thinking

- 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.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
- 8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.12.EG.3: Explain how individuals and businesses influence government policies

9.2 Career Readiness, Life Literacies, and Key Skills

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

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- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.3 Career & Technical Education (CTE)

- 9.3.12.AG-PST.1: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
- 9.3.12.AC-DES.1: Justify design solutions through the use of research documentation and analysis of data.
- 9.3.ST-ET.1: Use STEM concepts and processes to solve problems involving design and/or production.
- 9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects
- that address real world problems.
- 9.3.12.AG-ENV.3: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- 9.3.GV-SEC.5: Develop strategies to defend against and respond to the effects of chemical, biological, radiological, nuclear (CBRN) or other emergent events.

9.4 Life Literacies & Key Skills

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Evidence of Student Learning	
Formative Tasks: ● Oral Questioning ● Student Conference ● Self-Assessment ● Hand Signals ● Communicators ● Graphic Organizers ● Teacher Observation ● DOL ● Quiz Classwork ● NJSLA Released questions ● Problem of the Day	**Alternative Assessments:** ● Teacher-Created Projects ● https://www.khanacademy.org/ ● Completion of webquests ● On-Line Laboratory activities ● Online assessment activities example: ○ Kahoot ○ Quizizz
Summative Assessments: ● Unit Tests ● Midterm Exam ● Final Exam	**Benchmark Assessments:** ● Quarterly Benchmarks ● Beginning/End of Year Assessment ● Unit Common Assessment

Knowledge & Skills	
Enduring Understandings:	**Essential Questions:**

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• The periodic table is a powerful model that organizes elements based on repeating patterns in valence electrons and atomic structure. • An element's electron configuration largely determines its chemical properties and reactivity. • Chemical reactions occur as a result of interactions between valence electrons, and periodic trends help predict reaction outcomes. • Observable properties of substances at the bulk scale reflect particle-level structure and the strength of electrical forces between particles. Scientific investigations provide evidence that links microscopic interactions to macroscopic behavior of matter. Engineering solutions to real-world problems require evaluating evidence and balancing competing criteria and constraints. • Computer simulations allow scientists and engineers to model complex systems and predict the impacts of proposed solutions. • Effective decision-making in science and engineering considers not only performance, but also safety, cost, reliability, and societal and environmental impacts.	• How does the arrangement of electrons in an atom influence an element's position and properties on the periodic table? • In what ways can periodic trends be used to predict the outcomes of simple chemical reactions? How do interactions between valence electrons explain why substances form different types of bonds? How can evidence from bulk-scale investigations be used to infer particle-level electrical forces? • Why are models such as the periodic table essential for understanding and predicting chemical behavior? • How do engineers evaluate solutions when multiple criteria and constraints must be considered? • How can computer simulations improve our understanding of complex systems and proposed solutions? • How do social, environmental, and cultural factors influence scientific and engineering decisions?
Content *Students will know…* • Different patterns may be observed at each of the scales at which a system is studied, and these patterns can provide evidence for causality in explanations of phenomena. • Each atom has a charged substructure. • An atom's nucleus is made of protons and neutrons and is surrounded by electrons. • The periodic table orders elements horizontally by the number of protons in the nucleus of each element's atoms and places elements with similar chemical properties in columns. • The repeating patterns of this table reflect patterns of outer electron states. • Patterns of electrons in the outermost energy level of atoms can provide evidence for the relative properties of elements at different scales.	**Skills** *Students will be able to …* • Use the periodic table as a model to provide evidence for relative properties of elements at different scales based on the patterns of electrons in the outermost energy level of atoms in main group elements. • 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 in main group elements. • Use valid and reliable evidence (obtained from students' own investigations, models, theories, simulations, and peer review) showing the outermost electron states of atoms, trends in the periodic table, and patterns of chemical properties to construct and revise an explanation for the outcome of a simple chemical reaction. • Use the assumption that theories and laws that describe the outcome of simple chemical reactions operate today as they did in the past and will continue to do so in the future. • Observe patterns in the outermost electron states

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- 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.
- The periodic table orders elements horizontally by the number of protons in the nucleus of each element's atoms and places elements with similar chemical properties in columns.
- The repeating patterns of the periodic table reflect patterns of outer electron states.
- 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.
- Different patterns may be observed at each of the scales at which a system is studied, and these patterns can provide evidence for causality in explanations of phenomena.
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
- 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.
- 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.
- Engineering advances have led to important discoveries in space science, and scientific discoveries have led to the development of entire industries and engineered systems.
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
- 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.
- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, aesthetics, and to consider social, of atoms, trends in the periodic table, and chemical properties.
- Use the conservation of atoms and the chemical properties of the elements involved to describe and predict the outcome of a chemical reaction.
- Plan and conduct an investigation individually and collaboratively to produce data that can serve as the basis for evidence for comparing the structure of substances at the bulk scale to infer the strength of electrical forces between particles. In the investigation design, decide on types, how much, and accuracy of data needed to produce reliable measurements; consider limitations on the precision of the data (e.g., number of trials, cost, risk, time); and refine the design accordingly.
- Use patterns in the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- Communicate scientific and technical information about why the molecular - level structure is important in the functioning of designed materials.
- Evaluate a solution to a complex real-world problem based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoffs considerations to determine why the molecular level structure is important in the functioning of designed materials.
- Use mathematical models and/or computer simulations to show why the molecular level structure is important in the functioning of designed materials.
- Communicate scientific and technical information about the attractive and repulsive forces that determine the functioning of the material.
- Use mathematical models and/or computer simulations to show the attractive and repulsive forces that determine the functioning of the material.
- Examine in detail the properties of designed materials, the structure of the components of designed materials, and the connections of the components to reveal the function.
- Use models (e.g., physical, mathematical, computer models) to simulate systems of designed materials and interactions--including energy, matter, and information flows--within and between designed materials at different scales.

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cultural, and environmental impacts. ● Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. ● Models (e.g., physical, mathematical, computer models) can be used to simulate why the molecular-level structure is important in the functioning of designed materials.	

Core Instructional & Supplemental Materials	
Suggested Activities/Resources: ● Lab: ○ Graphing the Periodic Table ○ Basic of Periodic Table ○ Periodic Table Trends ○ The Case of the Misbehaving Balloon ○ Evaporation of Alcohols ○ Water Basic ○ Graphene	**Supplemental resources:** ● https://njctl.org/courses/science/chemistry/ ● https://betterlesson.com/next_gen_science/browse/2268/ngss-hs-ps1-1-use-the-periodic-table-as-a-model-to-predict-the-relative-properties-of-elements-based-on-the-patterns-of-electron ● https://www.pbslearningmedia.org/resource/lsps07.sci.phys.matter.graphperiodic/graphing-the-periodic-table/#.W3cIrCMrL_Q ● https://betterlesson.com/next_gen_science/browse/2269/ngss-hs-ps1-2-construct-and-revise-an-explanation-for-the-outcome-of-a-simple-chemical-reaction-based-on-the-outermost-electron ● https://njctl.org/courses/science/chemistry/ ● https://www.chemedx.org/blog/chemical-mystery-4-case-misbehaving-balloon?_ga=1.236602306.2141822034.1388690367 ● http://www2.vernier.com/sample_labs/PSV-04-COMP-evaporation_alcohols.pdf ● https://www.3dmoleculardesigns.com/Teacher-Resources/Water-Kit/Basic-Lesson-Plans.htm?docid=353& ● https://njctl.org/courses/science/chemistry/ ● https://ngss.nsta.org/Resource.aspx?ResourceID=250 ● Race & Social Justice Teacher Resources ● Molecular Reactions

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Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

504 Plans:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments

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- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

Gifted and Talented:

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

Students at Risk of Failure:

- Extended Time
- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Tiered Activities
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

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Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

Unit 5: Reactions	35 days

New Jersey Learning Standards-Science

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-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
HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
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.

Science and Engineering Practices	Discipline Core Ideas/Unit Enduring Understandings	Crosscutting Concepts
Developing and Using Models	**PS1.A: Structure and Properties of Matter**	**Patterns** · Different patterns may be observed at

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· Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8) · Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) **Planning and Carrying Out Investigations** · Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3) **Using Mathematics and Computational Thinking** · Use mathematical representations of phenomena to support claims. (HS-PS1-7) **Constructing Explanations and Designing Solutions** · Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) · Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations,	· Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) · The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) · The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6) · 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. (HS-PS1-4) **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. (HS-PS1-4),(HS-PS1-5) · 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. (HS-PS1-6) · The fact that atoms are conserved, together with knowledge of the chemical	each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-2), (HS-PS1-3), (HS-PS1-5) **Energy and Matter** · In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons are conserved. (HS-PS1-8) · The total amount of energy and matter in closed systems are conserved. (HS-PS1-7) · 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. (HS-PS1-4) **Stability and Change** · Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) **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. (HS-PS1-7)

peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) · Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6) **Asking Questions and Defining Problems** · Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1) **Using Mathematics and Computational Thinking** · Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4) **Constructing Explanations and Designing Solutions** · Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2) · Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)	properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7) **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. (HS-PS1-8) **PS2.B: Types of Interactions** · Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.(secondary to HS-PS1-1),(secondary to HS-PS1-3) **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 to HS-PS1-6) **ETS1.A: Defining and Delimiting Engineering Problems** · 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. (HS-ETS1-1) · Humanity faces major global challenges today, such as the need	

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	for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1) **ETS1.B: Developing Possible Solutions** · When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) · Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4) **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. (HS-ETS1-2)	

Social and Emotional Learning Standards	
Self-Awareness	● Recognize one's personal traits, strengths, and limitations ● Recognize the importance of self-confidence in handling daily tasks and challenges

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Self-Management	• Recognize the skills needed to establish and achieve personal and educational goals • Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	• Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	• Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA 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.
• **W.WR.11–12.5**	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.
• **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.
• **SL.AS.11–12.6**	Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.
• **RL.CR.11–12.1**	Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.
• **SL.PE.11–12.1**	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
	Math Standards
• **MP.4**	Model with mathematics.
• **HSN-Q.A.3**	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

Grade: High School	Content Area: Science - Integrated

8.2 Design Thinking

- 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.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
- 8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.12.EG.3: Explain how individuals and businesses influence government policies

9.2 Career Readiness, Life Literacies, and Key Skills

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.3 Career & Technical Education (CTE)

- 9.3.12.AG-PST.1: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
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- 9.3.ST-SM.2: Apply science and mathematics concepts to the development of plans, processes and projects
- that address real world problems.
- 9.3.12.AG-ENV.3: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- 9.3.GV-SEC.5: Develop strategies to defend against and respond to the effects of chemical, biological, radiological, nuclear (CBRN) or other emergent events.

9.4 Life Literacies & Key Skills

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Evidence of Student Learning

Formative Tasks:	Alternative Assessments:
• Oral Questioning • Student Conference • Self-Assessment • Hand Signals	• Teacher-Created Projects • https://www.khanacademy.org/ • Completion of webquests • On-Line Laboratory activities

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● Communicators ● Graphic Organizers ● Teacher Observation ● DOL ● Quiz Classwork ● NJSLA Released questions ● Problem of the Day	● Online assessment activities example: ○ Kahoot ○ Quizizz
Summative Assessments: ● Unit Tests ● Midterm Exam ● Final Exam	**Benchmark Assessments:** ● Quarterly Benchmarks ● Beginning/End of Year Assessment ● Unit Common Assessment

Knowledge & Skills	
Enduring Understandings: ● Chemical reactions involve the breaking and forming of bonds, and these processes determine whether energy is released or absorbed. ● Changes in total bond energy explain why some reactions are exothermic while others are endothermic. ● Reaction rates depend on particle interactions, which are influenced by temperature, concentration, and collision frequency. Chemical systems reach equilibrium when forward and reverse reactions occur at equal rates. ● Altering conditions in a chemical system can shift equilibrium and change the amounts of products formed. ● Atoms are conserved during chemical reactions, and mass remains constant even as substances change form. ● Mathematical representations provide evidence to support conservation laws in chemical processes. ● Complex chemical and real-world problems can be addressed by breaking systems into smaller components and refining solutions through engineering design.	**Essential Questions:** ● How does bond energy determine whether a chemical reaction releases or absorbs energy? ● What factors influence how quickly a chemical reaction occurs? ● How do temperature and concentration affect particle collisions and reaction rates? ● What does chemical equilibrium reveal about competing processes within a system? ● How can changing conditions in a reaction system increase product formation? ● How do mathematical models demonstrate the conservation of mass during chemical reactions? Why is it important to analyze chemical systems in smaller, manageable parts when designing solutions? ● How can engineering design principles be applied to optimize chemical processes?
Content *Students will know…* ● chemical properties of the elements involved, can be used to describe and predict chemical reactions.	**Skills** *Students will be able to …* ● Use mathematical representations of chemical reaction systems to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

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- The total amount of energy and matter in closed systems is conserved.
- The total amount of energy and matter in a chemical reaction system is conserved.
- 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.
- Changes of energy and matter in a chemical reaction system can be described in terms of energy and matter flows into, out of, and within that system.
- A stable molecule has less energy than the same set of atoms separated; at least this much energy must be provided in order to take the molecule apart.
- 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.
- Changes of energy and matter in a chemical reaction system can be described in terms of collisions of molecules and the rearrangements of atoms into new molecules, with subsequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
- 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.
- 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.
- 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.
- Patterns in the effects of changing the temperature or concentration of the reacting particles can be used to provide evidence for causality in the rate

- Use mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and products and the translation of these relationships to the macroscopic scale, using the mole as the conversion from the atomic to the macroscopic scale.
- Use the fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, to describe and predict chemical reactions.
- Describe changes of energy and matter in a chemical reaction system in terms of energy and matter flows into, out of, and within that system.
- Explain the idea that a stable molecule has less energy than the same set of atoms separated.
- Describe changes of energy and matter in a chemical reaction system in terms of energy and matter flows into, out of, and within that system.
- Describe chemical processes, their rates, and whether or not they store or release energy 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.
- Develop a model based on evidence to illustrate the relationship between the release or absorption of energy from a chemical reaction system and the changes in total bond energy.
- Use the number and energy of collisions between molecules (particles) to explain the effects of changing the temperature or concentration of the reacting articles on the rate at which a reaction occurs.
- Use patterns in the effects of changing the temperature or concentration of the reactant particles to provide evidence for causality in the rate at which a reaction occurs.
- Apply scientific principles and multiple and independent student-generated sources of evidence to provide an explanation of the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- Construct explanations for how chemical reaction systems change and how they remain stable.
- Design a solution to specify a change in conditions that would produce increased amounts of products at equilibrium in a chemical system based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Break down and prioritize criteria for increasing amounts of products in a chemical system at equilibrium.
- Refine the design of a solution to specify a change

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at which a reaction occurs. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● 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. ● 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 may be needed. ● Explanations can be constructed explaining how chemical reaction systems can change and remain stable.	in conditions that would produce increased amounts of products at equilibrium in a chemical system based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Core Instructional & Supplemental Materials

Suggested Activities/Resources:

- Lab:
  - Chemical Reactions Labs
  - Absorption and Release of Energy Labs
  - Chemical Reaction Rate
  - Red Alert
  - Chemical Reaction and Stechiometria
  - All Things being equal
  - Thermochemistry

Supplemental resources:

- https://njctl.org/courses/science/chemistry/
- https://betterlesson.com/next_gen_science/browse/2274/ngss-hs-ps1-7-use-mathematical-representations-to-support-the-claim-that-atoms-and-therefore-mass-are-conserved-during-a-chemica
- https://njctl.org/courses/science/chemistry/
- https://betterlesson.com/next_gen_science/browse/2271/ngss-hs-ps1-4-develop-a-model-to-illustrate-that-the-release-or-absorption-of-energy-from-a-chemical-reaction-system-depends-upo
- https://njctl.org/courses/science/chemistry/
- http://www.cpalms.org/Public/PreviewResourceLesson/Preview/51001
- https://www.gvsu.edu/targetinquiry/tidocuments/files/tidocuments/F96CB79C-E051-C65D-A0A84919955CAE15.pdf
- https://learn.concord.org/resources/113/chemical-reactions-and-stoichiometry
- https://njctl.org/courses/science/chemistry/
- https://www.gvsu.edu/targetinquiry/tidocuments/files/tidocuments/A45CB4BB-06C1-8CE5-AEC2B762EA519B50.pdf
- https://betterlesson.com/lesson/639979/final-review-lab-2-thermochemistry-nuclear-and-equilibrium
- Race & Social Justice Teacher Resources

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	• Chemical Reactions

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

504 Plans:

- Extra help opportunities provided
- Credit Recovery

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- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
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- Use of manipulatives
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- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

Gifted and Talented:

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

Students at Risk of Failure:

- Extended Time
- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Tiered Activities
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration

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- Assistive Technology
- Credit Recovery

Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background