Science 8

Unit Title: **Unit 1: Light and Matter (10 days)**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Science and Engineering Practices (SEP)

- **Asking Questions and Defining Problems:**
  This unit intentionally develops this practice. Students ask "what happens if" questions to guide initial investigations with the box models in Lesson 2. They co-construct an experimental, testable question to guide a controlled investigation in Lesson 3. They ask "how" and "why" questions to motivate investigations and to explain the phenomenon (Lessons 4- 7). Three Asking Questions Tools are provided to scaffold asking different kinds of questions. Open and Closed Questions (Asking Questions Tool): Use this tool to support students in revising close-ended questions into open ended ones. Avoid using it when students first offer questions for the DQB. Rather, use it later in a unit to transform close-ended questions into open-ended ones to investigate together. Testable Questions (Asking Questions Tool): Use this tool to support students in asking testable questions that include enough specific information that one could gather evidence (e.g., measurements, observations) to answer the question. Note that this tool includes testable questions that are not specifically experimental ones, but ones that can be answered by gathering empirical evidence. Experimental Questions (Asking Questions Tool) Use this tool to support students in asking experimental questions in which they will need to manipulate a variable in the system to observe its relationship to other variables.

- **Developing and Using Models:**
  This unit intentionally develops this practice. In the first lesson, students discuss how to use physical models to test ideas about a phenomenon (i.e., the box model) and how to use diagrammatic models to represent and explain the phenomenon. They contrast the real-world system they are trying to understand (i.e., two rooms in the video) with their box models to consider limitations of physical models. In subsequent lessons, students discuss representation choices for diagrammatic models, such as using symbols and colors, and what these representations communicate about the phenomenon. New elements of modeling that emerge in 6-8th grades that are developed in this unit include modeling parts of the system at unobservable scales, including unobservable mechanisms that explain observable phenomena (e.g., light reflecting off microscopic, half-silvered, one-way mirror film) in Lesson 4, and modifying a model to match if a variable is changed (e.g., changing the light conditions or swapping the one-way mirror for glass) (Lesson 8).

- **Constructing Explanations and Designing Solutions**.
  This unit intentionally develops constructing written explanations. In Lesson 7 students develop a written explanation for the phenomenon. First, they collaboratively write an explanation to one of their questions, with the teacher modeling how to write an explanation supported by a how and why account and evidence. Then

students independently write an explanation for a second question about the phenomena, receive feedback from the teacher and peers, and revise their explanations.

Disciplinary Core Ideas (DCI)

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (PS4.B)

- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (PS4.B)

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (LS1.D)

Crosscutting Concepts (CCC)

- **Systems and System Models** - Models can be used to represent systems and their interactions— such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1), (MS-PS2-4), (MS-ESS1-2)

- **Structure and Function**
  The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

- **Cause and Effect** - Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3), (MS-PS2-5)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.
9.4.8.DC.1	Analyze the resource citations in online materials for proper use.	Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.
9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	

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9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

Central Idea/Enduring Understanding:

Open Sci Ed: Light and Matter

- How can something act like a mirror and a window at the same time?
- What happens if we change the light? Lesson 3: What happens when light shines on the one-way mirror?
- How do similar amounts of light transmit through and reflect off the one-way mirror?
- How do light and the one-way mirror interact to cause the one-way mirror phenomenon? Lesson 6: Why does the music student not see the teacher?
- Why do the music student and the teacher see the music student but the music student can't see the teacher?
- Why do we sometimes see different things when looking at the same object?

Essential/Guiding Question:

Why do we sometimes see different things when looking at the same object?

Content:

Open Sci Ed: Light and Matter Lessons 1-8

Lesson 1 Phenomena/Design Problem
A piece of material looks like a mirror from one side and a window from the other side.

Lesson 2 Phenomena/Design Problem
The one-way mirror phenomenon happens when there is a difference in light between the two sides of the material.

Skills(Objectives):

- Develop a model to identify the important parts of the system and how those parts interact that could cause an object to look different in different light conditions.
- Ask questions that arise from observations of a phenomenon in which an object appears different depending on the light conditions within the defined system.
- Ask questions that can be investigated in the classroom and frame a hypothesis about what we will see from both sides of the box model if we change the amount of light on either side (structure).

Lesson 3 Phenomena/Design Problem The one-way mirror phenomenon happens when there is a difference in light between the two sides of the material. Lesson 4 Phenomena/Design Problem A one-way mirror has a thin silver layer compared to a regular mirror that is fully silvered and glass that is not silvered. Lesson 5 Phenomena/Design Problem The one-way mirror acts as a mirror on the lit side and as a window on the dark side. Lesson 6 Phenomena/Design Problem What we see is determined by the interactions between the light that enters the eye, the structures that make up the eye, and the brain, which processes the signals it receives from the eye through the optic nerve. Lesson 7 Phenomena/Design Problem The music student can see his reflection in the mirror on the lit side but cannot see the teacher. The teacher on the dark side can see the music student through the glass. Lesson 8 Phenomena/Design Problem Materials like glass can act like one-way mirrors when there is a differential in light on both sides of the glass	• Modify a model based on evidence to match changes in what we see when we change the light in the box model (structure). • Ask a testable question to determine how an object's material (structure; independent variable) influences the amount of light transmitted and reflected (function; dependent variable). • Use evidence to modify a model to explain how an object's material (structure) influences the path of light as it transmits through or reflects off the material (function). • Develop a model to describe the unobservable mechanisms that affect how a material's microscale structures change how light reflects off and transmits through the material (function). • Revise a model to explain the observable one-way mirror phenomenon caused by unobservable interactions between light, the people, and the one-way mirror, which reflects and transmits about the same amount of light. • Ask questions to model the path of light as it travels through the lens of the eye, and to explain how the shape and composition of the lens causes the path of light to change directions (refract) before reaching the retina at the back of the eye. • Develop a model that describes how the eye responds to (interacts with) different inputs of light and transforms those inputs to signals that travel along the optic nerve to the brain, which processes the signals into what we "see." • Construct and revise an explanation using a model to explain why an object appears different (effect) depending on the interaction between light and an object's material and how the brain processes signals (causes). • Use a model to describe how differences in light on both sides of a one-way mirror strengthens or weakens the one-way mirror phenomenon due to changing the components and interactions within and between systems. • Apply science ideas and evidence from classroom investigations to explain a common, real-world phenomena in which a material designed for light transmission
Interdisciplinary Connections: ***ELA/Literacy -NJSLS*** **SL.UM.8.5.** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. **W.SE.8.6.** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.	

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Stage 2: Assessment Evidence	
Performance Task(s): ● Waves Go Public! Students apply everything they have learned over the course of the associated lessons about waves, light properties, the electromagnetic spectrum, and the structure of the eye, by designing devices that can aid color blind people in distinguishing colors. https://www.teachengineering.org/activities/view/clem_waves_activity ● Edulastic Unit Assessment ● Sheep Eye Dissections	**Other Evidence:** Do Nows Classwork Interactive Notebook Class discussions Closure activities (ex. exit tickets, kahoots, KWL charts) Personal digital responses (Kahoot, Quizizz, Quizlet, etc.) Homework Teacher observation Graphic Organizers Scientific inquiry analysis Common Formative Assessments Summative Unit Assessments

Stage 3: Learning Plan	
Learning Opportunities/Strategies: ● PhET: Bending Light https://phet.colorado.edu/en/simulation/bending-light ● What's the frequency, Roy G. Biv? https://imagine.gsfc.nasa.gov/educators/lessons/roygbiv/ Teaching Scientific Practices ● Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.) ● Students will utilize the engineering and design process to ask questions, plan and carry out investigations, refine models, design solutions, construct explanations, and design solutions. Literacies ● Use reading strategies to read non-fiction text (preview, question, reflect, highlight, recite, review, utilize text structure, etc.) ● Digital tools - utilize features available on ebooks such as highlighting, bookmarking, linking to more information, etc. ● Digital literacy - Find and evaluate digital sources. Communicate clearly using digital platforms Questioning - Present guiding leveled questions to students. See differentiation section for specific questions. ● Formative assessment response modalities	**Resources:** - OpenSciEd - Get Ready to Read - Launch Labs - Content Vocabulary - MiniLabs - Content Practice worksheets - Math Skills - Enrichment - Challenge - Lesson Quizzes - Kessler Science - Labs - Key Concept Builder activities - Chapter Tests - Online quiz - Online Standardized Test Practice - YouTube videos - BrainPop videos - Flocabulary - Newsela - Readworks.org - Scholastic Science World magazine - Planet Earth "Caves" - Edulastic - IXL - NMSI - NGSS Phenomena: https://www.ngssphenomena.com LGBT and Disabilities Resources: ● LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth ● LGBTQ+ Books DEI Resources: ● Learning for Justice

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• Teacher/student question discussion • Thumbs up/thumbs down • Rate yourself on understanding on a fist to five scale • Google Forms • Digital polling devices (Kahoot, Quizizz, etc.) • Exit tickets/responses • Whiteboards Learning Strategies • Think, Pair, Share • Direct instruction • Jigsaw • Cooperative groups • Discussion in class and discussion boards • Socratic Seminar Learning Management • Google Classroom - share information with students, post assignments, collect feedback • Google Docs & Google Slides - creation and presentation tools	• GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation
*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	**On Grade Level Students**	**Struggling Students**	**Special Needs/ELL**
Page Keeley Science Probes Interactive Science notebooks - higher level of Costa's questions created Scaffolded guiding questions - above level Less structure provided for assignments / assessments Heterogeneous grouping Research independently or collaboratively with minimal teacher guidance Laboratory investigations designed and carried out by students	Interactive Science notebooks Scaffolded guiding questions - on level Provide challenging tasks with support to allow students to experience success Moderate amount of scaffold on assignments Heterogeneous grouping Laboratory investigations designed by students with teacher assistance and	Interactive Science notebooks - templates provided by teacher Scaffolded guiding questions - below level Break down assignments into smaller tasks Structured, predictable classroom Graphic organizers/Study guides provided Copy of class notes/presentation provided to student Utilize student's best personal learning	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

	carried out by students	modality (auditory, visual, kinesthetic) Heterogeneous grouping Laboratory investigations provided by teacher for students to carry out	

Unit Title: **Unit 2: Thermal Energy**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Science and Engineering Practices (SEP)

- **Developing and Using Models**: This unit intentionally develops this practice by providing explicit instruction and scaffolds to support students in modeling particle scale mechanisms that result in observable heating and cooling phenomena. These include modeling templates, physical manipulatives (e.g., chips, marbles), and computer simulations. Students develop models for explaining how unobservable mechanisms result in observable phenomena which is a new context compared to the micro scale that was modeled in the One-way Mirror Unit. Because of particle-scale mechanisms, simulations are necessary to support students in modeling relationships among variables. Students also develop models to plan for the cup design challenge, and to explain how their cup designs work to minimize energy transfer.

- **Planning and Carrying Out Investigation**. This unit intentionally develops the practice. Students are given the opportunity to explore initial questions they have about cups through uncontrolled investigation, and then through a series of highly controlled investigations, to come to the conclusion that matter is not moving between systems, but rather energy is transferring between systems. Students articulate independent, dependent, and control variables; they co-construct collaborative investigation procedures to follow; reflect on ways to minimize error in their procedures; and fine tune procedures. In the design challenge, they define procedures to conduct fair tests under a range of conditions, and revisit those procedures to fine tune them before they conduct tests on their optimized designs. Students are assessed on this practice in a midpoint assessment.

- **Analyzing and Interpreting Data**: This unit intentionally develops this practice. Students work with data throughout the unit as they run investigations and use data as evidence for their claims about phenomena to design their own devices. Students calculate means from pooled data across the class. They consider limitations of data analysis when the teacher explains the accuracy of the digital scale (+/- 0.1 g). Students discuss how averaging multiple measurements from many trials can help counterbalance this source of error. They also use their data to modify their data collection methods to work toward more precise data collection.

- C**onstructing Explanations and Designing Solutions:** This unit intentionally develops this practice. Students use scientific ideas to construct and test an object that is designed to slow energy transfer. Students articulate precise criteria and constraints for the design challenge, and identify how to test the devices against those criteria and constraints. They undertake this design project with multiple design cycles in which students tweak design features to optimize their device's performance. Students explain how features of their device worked and why and which features did not work and why, connecting these back to the criteria and constraints agreed upon for the design challenge.

Disciplinary Core Ideas (DCI)

- Conservation of Energy and Energy Transfer When the kinetic energy of an object changes, there is inevitably some other change in energy at the same time. The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. Energy is spontaneously transferred out of hotter regions or objects and into colder ones (lPS3.B)

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (PS4.B)

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (ETS1.A.)

- A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (ETS1.B.)

Crosscutting Concepts (CCC)

- **Systems and System Models** - Models can be used to represent systems and their interactions— such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1), (MS-PS2-4), (MS-ESS1-2)

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- **Structure and Function**-The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)
- **Cause and Effect** - Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3), (MS-PS2-5)
- **Patterns**-Patterns can be used to identify cause and effect relationships.(MS-LS2-2)
- **Energy and Matter**-The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.
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9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	
9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

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Central Idea/Enduring Understanding:	Essential/Guiding Question:
• Why does the temperature of the liquid in some cup systems change more than in others? • What cup features seem most important for keeping a drink cold? • How are the cup features that keep things cold the same or different for keeping things hot? • How does a lid affect what happens to the liquid in the cup? • Where does the water on the outside of the cold cup system come from? • How can we explain the effect of a lid on what happens to the liquid in the cup over time? Lesson 7: If matter cannot enter or exit a closed system, how does a liquid in the system change temperature? • How does a cup's surface affect how light warms up a liquid inside the cup? • How does the temperature of a liquid on one side of a cup wall affect the temperature of a liquid on the other side of the wall? • What is the difference between a hot and a cold liquid? • Why do particles move more in hot liquids? • How does the motion of particles compare in a sample of matter at a given temperature? • How could the motion of particles on one side of a solid wall affect the motion of the particles on the other side of that wall?	How can containers keep stuff from warming up or cooling down?

• Does our evidence support that cold is leaving the system or that heat is entering the system? • How do certain design features slow down the transfer of energy into a cup? • How can we design a cup system to slow energy transfer into the liquid inside it? • How can we improve our first design to slow energy transfer into the cup system even more? • How can containers keep stuff from warming up or cooling down?	
Content: **Open Sci Ed: Thermal Energy Lessons 1-18** Lesson 1 Phenomena/Design Problem: Makers of a fancy plastic cup claim it keeps a drink cold for longer than a regular plastic cup. Lesson 2 Phenomena/Design Problem: There are features of a cup that are important for keeping a drink cold. Lesson 3 Phenomena/Design Problem: Students test whether cups that can keep liquids cold can also keep liquids hot. Lesson 4 Phenomena/Design Problem: Hot liquid in a cup with a lid changes temperature less than in a cup without a lid. The amount of matter lost to the surroundings due to evaporation is less too. A completely closed system loses no matter to the surroundings, even though the liquid in it still changes temperature. Lesson 5 Phenomena/Design Problem: Observe and measure closed cup systems containing cold liquids before and after water droplets form on the outside surface of the cup system. Lesson 6 Phenomena/Design Problem: A completely closed system loses no matter to the surroundings, even though the liquid in it changes temperature over time. Lesson 7 Phenomena/Design Problem:	**Skills(Objectives):** • Develop an initial model to describe a phenomenon in which a substance changes temperature and identify structural parts of the system that slow down or speed up the temperature change (function). • Plan and carry out an investigation to gather evidence to answer scientific questions about how parts of the cup system relate to the temperature change of the liquid inside. • Analyze and interpret data to find patterns indicating which parts of the cup system (features) influence the temperature change of the substance inside the system • Develop and use a model to explain how the best-performing and worst-performing cup systems affect the temperature change of a substance inside a system • Plan an investigation to investigate how the lid (a structural feature of the cup system) works to slow the temperature change (function) of a substance inside the system. • Plan and carry out investigations to determine the effect of a lid on temperature change and mass change in systems that are more open and less open • Develop Analyze and interpret data by applying concepts of probability to calculate the mathematical mean to compare the temperature change and mass change across conditions (patterns) and use these measures to make claims about the effect of the lid. • Develop a model to describe why mass is lost in some conditions but not others (open systems versus less-open systems), using a particle model of matter for liquids and gasses. • Collect and analyze different forms of data to identify patterns across our data sources that serve as evidence that condensation that forms on the outside surface of a cold cup system comes from the air outside the system. • Construct an argument to support the claim that water forming on the outside surface of a cold cup system

Other possible interactions could cause a temperature change in the liquid inside the closed cup system. Lesson 8 Phenomena/Design Problem: Water warms up differently in cups with various surfaces when light shines on the cups, and it warms up in a completely dark condition too. Lesson 9 Phenomena/Design Problem: The temperature increases and decreases inside a cup system are correlated with temperature decreases and increases outside the cup system. Lesson 10 Phenomena/Design Problem: Candy breaks into pieces and dissolves more quickly in hot water than cold water. Food coloring moves around and spreads out more in hot water than cold water. When water is shaken vigorously, the water warms up. Lesson 11 Phenomena/Design Problem: A simulation shows that particles move slower when a liquid is cold and faster when a liquid is hot. Lesson 12 Phenomena/Design Problem: When particles collide, they transfer their kinetic energy to each other, and in a sample of matter at the same temperature, the particles have different speeds. Lesson 13 Phenomena/Design Problem: When a fast-moving glass marble hits a slow moving glass marble moving in the same direction, the fast-moving marble slows down and the slow-moving marble speeds up. When a moving glass marble hits a line of magnet marbles held in place, the glass marbles on the other side of the magnetic marbles start moving. Lesson 14 Phenomena/Design Problem: Butter melts when a candle is lit on one side of a strip of aluminum foil. Lesson 15 Phenomena/Design Problem: Certain design features, such as double walls,	comes from the air outside the system and is not leaving the system through the walls. ● Develop and use a particle model of matter for solids, liquids, and gasses to show how structural differences in a cup system allow water molecules to leave the system at some points in the system but not at others. ● Plan an investigation and in the design, identify the controls, the tools needed to gather the data, and how much data are needed to support a claim about how ● Develop two models to show relationships among the parts of the mostly closed cup system and how light and heat or cold (i.e., mechanisms) cause the liquid inside to warm up or cool down (effect). ● Develop and use models to describe how light transmission through, reflection off, and absorption by cup walls causes changes in the temperature (effect) of water inside the cup. ● Carry out an investigation to measure temperature inside and outside a cup system to test whether heat or cold moves through the wall of the system. ● Develop models based on evidence to explain that matter is made of particles that are in motion, and though the individual particles are not visible to the eye, their collective behavior can be observed as more or less movement depending on the matter's temperature ● Construct an explanation about why food coloring moves more in hot water than in cold water using the idea that at the particle scale, particles in liquids at warmer temperatures have more kinetic energy than particles in liquids at cooler temperatures. ● Analyze and interpret data to mathematically represent the cause-and-effect relationships between the average kinetic energy of the particles of a gas, the temperature of the gas, and the total kinetic energy of all the particles in the gas.

foam, and reflective materials, slow down or minimize the temperature increase of a liquid inside a cup system. Lesson 16 Phenomena/Design Problem: Certain design features slow energy transfer reflecting light or using air pockets or layers. Lesson 17 Phenomena/Design Problem: Cup designs that use fewer materials and reduce absorption of light and contact between materials are more effective. Lesson 18 Phenomena/Design Problem: Objects designed to keep things cold or hot share similar design features, like materials that create air insulation and have transparent or reflective surfaces.	

Interdisciplinary Connections:

ELA/Literacy -NJSLS

SL.PE. 6.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

SL.UM.8.5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

RI.MF.8.6. Evaluate the choices made (by the authors, directors, or actors) when presenting an idea in different mediums and the advantages and disadvantages of using different mediums or formats (e.g., visually, quantitatively) to address a question or solve a problem.

W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.

W.WR.8.5. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text.

Mathematics -NJSLS

MP.2 Reason abstractly and quantitatively.

6.SP.B.5 Summarize numerical data sets in relation to their context.

6. NS.C.5-Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Science 8

Stage 2: Assessment Evidence

Performance Task(s):

- Cooking with the Sun - Creating a Solar Oven: https://www.teachengineering.org/activities/view/duk_solaroven_tech_act
- Next Generation Science Assessment
- Hot Tea vs. Hot Chocolate Milk: https://authoring.concord.org/activities/5492
- Designing an Experiment: Sand vs. Salt: https://authoring.concord.org/activities/550
- Edulastic Unit Assessment

Other Evidence:

Do Nows
Classwork
Interactive Notebook
Class discussions
Closure activities (ex. exit tickets, kahoots, KWL charts)
Personal digital responses (Kahoot, Quizizz, Quizlet, etc.)
Homework
Teacher observation
Graphic Organizers
Scientific inquiry analysis
Common Formative Assessments
Summative Unit Assessments

Stage 3: Learning Plan

Learning Opportunities/Strategies:

Teaching Scientific Practices

- Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.)
- Students will utilize the engineering and design process to ask questions, plan and carry out investigations, refine models, design solutions, construct explanations, and design solutions.

Literacies

- Use reading strategies to read non-fiction text (preview, question, reflect, highlight, recite, review, utilize text structure, etc.)
- Digital tools - utilize features available on ebooks such as highlighting, bookmarking, linking to more information, etc.
- Digital literacy - Find and evaluate digital sources. Communicate clearly using digital platforms

Questioning - Present guiding leveled questions to students. See differentiation section for specific questions.

- Formative assessment response modalities
- Teacher/student question discussion
- Thumbs up/thumbs down
- Rate yourself on understanding on a fist to five scale
- Google Forms

Resources:

- Open SciEd
- Get Ready to Read
- Launch Labs
- Content Vocabulary
- MiniLabs
- Content Practice worksheets
- Math Skills
- Enrichment
- Challenge
- Lesson Quizzes
- Kessler Science
- Labs
- Key Concept Builder activities
- Chapter Tests
- Online quiz
- Online Standardized Test Practice
- YouTube videos
- BrainPop videos
- Flocabulary
- Newsela
- Readworks.org
- Scholastic Science World magazine
- Planet Earth "Caves"
- Edulastic
- IXL
- NMSI
- NGSS Phenomena: https://www.ngssphenomena.com

LGBT and Disabilities Resources:

Science 8

• Digital polling devices (Kahoot, Quizizz, etc.) • Exit tickets/responses • Whiteboards Learning Strategies • Think, Pair, Share • Direct instruction • Jigsaw • Cooperative groups • Discussion in class and discussion boards • Socratic Seminar Learning Management • Google Classroom - share information with students, post assignments, collect feedback • Google Docs & Google Slides - creation and presentation tools	• LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books DEI Resources: • Learning for Justice • GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Page Keeley Science Probes Interactive Science notebooks - higher level of Costa's questions created Scaffolded guiding questions - above level Less structure provided for assignments / assessments Heterogeneous grouping Research independently or collaboratively with minimal teacher guidance Laboratory investigations designed and carried out by students	Interactive Science notebooks Scaffolded guiding questions - on level Provide challenging tasks with support to allow students to experience success Moderate amount of scaffold on assignments Heterogeneous grouping Laboratory investigations designed by students with teacher assistance and carried out by students	Interactive Science notebooks - templates provided by teacher Scaffolded guiding questions - below level Break down assignments into smaller tasks Structured, predictable classroom Graphic organizers/Study guides provided Copy of class notes/presentation provided to student Utilize student's best personal learning modality (auditory, visual, kinesthetic)	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

		Heterogeneous grouping Laboratory investigations provided by teacher for students to carry out	

Unit Title: **Unit 3: Chemical Reactions and Matter**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.

MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-5: Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories

Science and Engineering Practices (SEP)

- **Planning and Carrying Out Investigations:** This practice is intentionally developed in this unit. While students have had experience in multiple 6th grade units with aspects of this practice, working as a class and in small groups, in this unit students deepen their use of the practice so that they can engage in a full design for investigations as individuals, and are assessed on this practice. In Lesson 2 students co-design 2 investigations with the whole class to determine where the gas is coming from when a bath bomb is placed in water. In Lesson 4, students co-plan and carry out an investigation with a small group to determine what combinations of bath bomb ingredients leads to a gas forming. Students continue to engage with this practice through the second half of the unit either with the whole class or in small groups. The final assessment includes them individually planning and carrying out an investigation on pieces of marble (calcium carbonate) to figure out why the surface of the marble on the Taj Mahal is crumbling. Students also propose what other investigations they would need to collect more evidence to help them more fully explain what is happening to the Taj Mahal.

- **Analyzing and Interpreting Data:** This unit intentionally develops this practice. While students have analyzed and interpreted data through many of the sixth grade units, in this unit students take on increasing responsibility for figuring out what data they need, how to collect it, and how to represent and analyze it. Students begin developing this practice starting in Lesson 2 when they argue in small groups and as a class for what data they need to collect and how they can record it to be able to do the analyses they need for their questions. In Lesson 3 they analyze their first property data table. As the unit progresses, students construct and analyze data tables to help them figure out different parts of the story of what is happening when the bath bomb is placed in water. They collect data to determine the substances in the bath bomb that cause the gas (Lesson 4), record data from flammability and density tests of gases and use a property data table to determine what gas could be produced (Lesson 5), and argue for what additional data they need to analyze (Lesson 7). Students analyze and interpret their data to provide evidence for phenomena as they analyze data to determine whether a chemical reaction has occurred in several new scenarios and argue for what additional data they would need to be more confident in their explanations.

- **Construct Explanations and Design Solutions and Engage in Argument from Evidence:** This unit intentionally develops both practices, which frequently work together in the unit. The unit contains support for teachers to guide students in more elaborated arguments and explanations, articulated both verbally and in writing, than in prior units. The first half of the unit supports students' growth in engaging in argument from evidence. The unit supports students in incrementally assembling a multiple step argument, supporting each step with evidence, for an explanation for what happens to the matter of the bath bomb in water. As students collect new data, information, or evidence, they pause to record new key model ideas (scientific principles) that they then use to construct arguments for their explanations of the various phenomena in the unit (bath bombs, elephant's toothpaste, electrolysis, or crumbling marble on the Taj Mahal). The second half of the unit focuses on helping students use the scientific ideas, principles, and evidence they have assembled to construct a mechanistic causal explanation for how the matter rearranges to form new substances leading to the gas product of the bath bomb in water.

Disciplinary Core Ideas (DCI)

- Substances are made from different types of atoms, which combine with one another in various ways. (PS1.A.)
- Atoms form molecules that range in size from two to thousands of atoms. (PS1.A.)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (PS1.A)
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (PS1.B.)
- The total number of each type of atom is conserved, and thus the mass does not change. (PS1.B.)
- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (LS1-D.)

Crosscutting Concepts (CCC)

- **Systems and System Models** - Models can be used to represent systems and their interactions— such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1), (MS-PS2-4), (MS-ESS1-2)

Science 8

- **Scale Proportion and Quantity** -Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)

- **Energy and Matter**-The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Career Readiness, Life Literacies and Key Skills

Standard	**Performance Expectations**	**Core Ideas**
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.
9.4.8.DC.1	Analyze the resource citations in online materials for proper use.	Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.
9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	
9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

Central Idea/Enduring Understanding:	**Essential/Guiding Question:**
• What happens when a bath bomb is added to water (and what causes it to happen)? • Where is the gas coming from?	How can we make something new that was not there before?

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• What's in a bath bomb that is producing the gas? • Which combinations of the substances in a bath bomb produce a gas? • What gas(es) could be coming from the bath bomb? • How can we explain another phenomenon where gas bubbles appear from combining different substances together? • How can we revise our model to represent the differences in the matter that goes into and comes out of the bath bomb system? • How can particles of a new substance be formed out of the particles of an old substance? • Does heating liquid water produce a new substance in the gas bubbles that appear? • When energy from a battery was added to water, were the gasses produced made of the same particles as were produced from heating the water? • How do Dalton's models of the particles that change in a reaction compare to the ones we developed? • How can a new substance (a gas) be produced and the total mass of the closed system not change? • Why do different substances have different odors and how do we detect them? • What is happening to the Taj Mahal?	
Content: **Open Sci Ed: Chemical Reactions Lesson 1-14** Lesson 1 Phenomena/Design Problem: When solid bath bombs are added to water, they start breaking apart, and gas bubbles appear on and around them for a few minutes, until no solid is left. Lesson 2 Phenomena/Design Problem: The mass of a bath bomb put in water in an airtight container does not change, but the mass decreases after the cap on the bottle is opened and gas is heard escaping Lesson 3 Phenomena/Design Problem" Bath bombs have different ingredients and recipes. The ingredients in them interact with water in	**Skills(Objectives):** • Develop a model showing what is happening at a scale smaller than we can see (patterns) to help explain what happened to the matter in the solid bath bombs (matter) and what caused the gas bubbles to appear (matter). • Ask questions that arise from our observations of different bath bombs before and after they were added to water in order to seek additional information about what caused the changes (effects) we saw occurring. This includes what happened to the matter in the solid bath bombs and what caused the gas bubbles to appear as well as what kind of changes are happening to the matter in examples of other related phenomena we raised. • Collaboratively plan and carry out an investigation in a closed system to answer the question, "Where does the gas produced by the bath bomb come from?" • Construct and present an oral and written argument supported by empirical evidence and scientific

different ways, but none cause bubbles to appear when added to water on their own. Lesson 4 Phenomena/Design Problem: Combining citric acid, baking soda, and water causes bubbles to appear. Lemonade mixes (which are made of specific substances, including citric acid) also caused bubbles when combined with water and baking soda. Lesson 5 Phenomena/Design Problem: A flame goes out when put into a container of pure helium gas, gas from a bath bomb, or air mixed with helium, but does not when put in air only. Lesson 6 Phenomena/Design Problem: When different substances are combined (potassium iodide and hydrogen peroxide), they interact and produce a gas. Lesson 7 Phenomena/Design Problem: No new phenomena are introduced in this lesson. We put the pieces together for all phenomena previously explored in Lessons 1 through 5. Lesson 8 Phenomena/Design Problem: Alternate models can help explain how to make new particles from old particles Lesson 9 Phenomena/Design Problem: Gas from heated water extinguishes a flame. Clear liquid collected when gas cools has a mass to volume ratio of 1 for any size sample. Lesson 10 Phenomena/Design Problem: When energy from a battery is added to water, two streams of gas bubbles are produced. When a lit match is put into trapped gas from these two sources, one pops and the other glows brighter. Lesson 11 Phenomena/Design Problem: There are many different ways (symbols, shapes, letters, numbers, and physical manipulatives) to represent the number, type, and arrangement of the atoms that make up the molecules of different substances.	reasoning to support the claim that gas is not trapped in the bath bomb to start with but must come from some change to the matter that was already in the system to begin with. ● Analyze and interpret data to identify patterns in the characteristic properties of substances. ● Plan and carry out an investigation to collect data to identify patterns in the characteristic properties of substances from a bath bomb when they are individually added to water. ● Conduct an investigation to produce data to serve as the basis for evidence to determine which combinations (patterns) of substances in a bath bomb cause bubbles of gas to appear (effect). ● Construct and present a written and oral argument supported by citing empirical evidence and scientific reasoning that only certain combinations (patterns) of substances (water, baking soda, and citric) result (cause) in the formation of a gas (effect). ● Apply scientific ideas and evidence (patterns in properties) to co-construct an explanation that the substance(s) in the gas bubbles must be a different substance(s) than the water, baking soda, or citric acid. ● Analyze and interpret the data for common gasses to look for patterns that could be used to identify an unknown gas by its characteristic properties. ● Apply scientific reasoning based on patterns in the densities for a known set of gasses to explain how either of two different possible outcomes from a future investigation could help us narrow down the sub-set of candidate substances from what could be in the unknown gas from the bath bomb. ● Apply key model ideas and patterns in mass and property data to construct three explanations for: a) why the mass of a system decreases when substances are mixed together, b) which substance(s) could or could not be produced in that process, and c) what additional tests could be done on the gas (or other gasses) to help identify additional substances that aren’t being produced in this process. ● Develop and revise a model to predict and describe the unseen interactions between particles in a system to show that matter is conserved in a process where the type of particles that make up the starting substances (system inputs) somehow change through their interactions to make different type(s) of particle(s) in the ending substances (system outputs). ● Ask questions related to the development of alternate models for what is happening to the matter at a particle level (patterns) when old substances interact to produce new substances by combining or rearranging parts/particles (systems and system models), and

Lesson 12 Phenomena/Design Problem: The mass of water captured in a container after a bath bomb reacts in it is greater than was initially in the container before the bath bomb was put in it. A white substance, with a different density and different solubility than any of the substances in the bath bomb is found in this container after the water is boiled off. Lesson 13 Phenomena/Design Problem: Some substances can be identified by their odor and each substance has a unique molecular structure. These odors are received by the receptors in our nose and signals are sent to our brain so we can recognize what the substance is. Lesson 14 Phenomena/Design Problem: The marble of the Taj Mahal is crumbling and falling apart.	determine ways we might go about investigating these ideas ● Use mathematical and computational thinking by graphing mass vs. volume data for different substances and finding the ratio of mass to volume (a unit rate) (scale, proportion, quantity) for the samples measured to determine the density of different clear liquids. ● Argue from evidence and critique two arguments on the same topic; strengthen these arguments by using additional empirical evidence (patterns) and scientific reasoning to support an explanation for whether the substances collected from the gas produced by the heated water is made of different types of particles or the same type of particles (patterns) as those in the water that we started with. ● Students apply scientific ideas and evidence (property data) to construct an explanation for whether the gas(es) produced from water using energy from a battery were made of the same particles (patterns) as those produced from heating the water ● Gather and communicate information from a scientific text adapted for classroom use to determine the central ideas of Dalton’s atomic theory with regard to the patterns in the particulate structure of matter that makes up all substances. ● Construct an explanation using models of the molecular structures of different substances to predict which gas must be produced (effect) in the bath bomb reaction based on the types of atoms that make up the substances (patterns), and use it to explain what is happening to the particles (matter) in the system to cause the production of this new substance. ● Construct an explanation for how the atoms in the molecules of the starting substances rearrange to form new products in the bath bomb, but the number and types of atoms do not change and thus mass is conserved and evaluate two different molecular models for different ratios of reactant and product molecules to determine which better supports this explanation. ● Construct an explanation for whether additional substances could have been produced in the bath bomb reaction based on the patterns in the atoms that make up the molecules of the different substances. ● Analyze and interpret data on the properties of substances (patterns) before and after substances interact to determine if the chemical reaction that produces gas in a bath bomb also produces another new substance.
Interdisciplinary Connections: ***ELA/Literacy* -*NJSLS***	

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RI.MF.8.6. Evaluate the choices made (by the authors, directors, or actors) when presenting an idea in different mediums and the advantages and disadvantages of using different mediums or formats (e.g., visually, quantitatively) to address a question or solve a problem.

RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text.

W.SE.8.6. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

Mathematics -NJSLS

MP.2 Reason abstractly and quantitatively.
MP.4 Model with mathematics.
6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
6.SP.B.5 Summarize numerical data sets in relation to their context.

Stage 2: Assessment Evidence

Performance Task(s):

- **Three States of Water** - Evaluate a model to determine if it shows the patterns of particle motion and spacing of solid, liquid, and gaseous states of water. https://authoring.concord.org/activities/5395

- **Red dye Diffusion** - Watch a video of red dye-coated candies being placed in different temperatures of water and then develop a model to show what happens to the dye particles in each temperature condition. https://authoring.concord.org/activities/5402/fbb8c3d9-7de9-44d1-9186-68d92adf6a95

- **Melting Butter** - Develop a model to explain what might happen to butter particles when thermal energy is transferred to a solid stick of butter. https://authoring.concord.org/activities/5425/09914467-dde8-40d7-856b-eb63a4ae4f47

- **Justin's Deflated Balloon** - Use a computer-based simulation to explain how the temperature of the helium gas in the balloon would change if the balloon was taken outside on a cold day.

Other Evidence:

Do Nows
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https://authoring.concord.org/activities/5474/8127d6b9-49af-481b-8825-7b0d264d2ae9

- Edulastic Unit Assessment
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<tr><th colspan="2">Stage 3: Learning Plan</th></tr>
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- Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.)
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Learning Management
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Resources:

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- MiniLabs
- Content Practice worksheets
- Math Skills
- Enrichment
- Challenge
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- Online Standardized Test Practice
- YouTube videos
- BrainPop videos
- Flocabulary
- Newsela
- Readworks.org
- Scholastic Science World magazine
- Planet Earth “Caves”
- Edulastic
- IXL
- NMSI
- NGSS Phenomena: https://www.ngssphenomena.com

LGBT and Disabilities Resources:
- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:
- Learning for Justice
- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List
- Respect Ability: Fighting Stigmas, Advancing Opportunities
- NJDOE Diversity, Equity & Inclusion Educational Resources
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• Google Classroom - share information with students, post assignments, collect feedback • Google Docs & Google Slides - creation and presentation tools	• Diversity Calendar

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Unit Title: **Unit 4: Chemical Reactions and Energy**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

MS-PS1-6: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Science and Engineering Practices (SEP)

- **Asking Questions and Defining Problems:** This unit intentionally develops this practice with a particular focus on Defining Problems. Students define a design problem that can be solved through the development of a flameless heater which includes consideration of multiple criteria and constraints. As students learn more about chemical reactions that transfer energy, they refine their criteria and constraints and revise their designs.

- **Analyzing and Interpreting Data:** This unit intentionally develops this practice. Students analyze data to define an optimal operational range for a flameless heater that best meets criteria for success. Students use a matrix to track how well their prototypes meet the criteria and constraints developed and further analyze the effects of design changes with regard to device performance, but also different impacts on various stakeholders.

- **Planning and Carrying Out Investigations:** This practice is key to student sensemaking in this unit. Students figure out what kind of data they need to collect to test their hypothesis that a chemical reaction is occurring in their flameless heaters. They perform investigations, collect data, and interpret the results to figure out that energy is transferred during a chemical reaction. Students use data they collect about energy transfer during several different chemical reactions under different conditions (proportion of reactants, amount of reactants and amount of food heated) to help them design their initial prototypes. Students evaluate the investigation procedure and the data collection methods to identify ways to improve the accuracy of data collection, and revise their methods for temperature data collection and qualitative observations of the products. As students test their designs, they collect data about the performance of the heater under a range of conditions (i.e. with different groups attempting to follow the instructions they designed), and use that evidence to inform redesign.

- **Constructing Explanations and Designing Solutions**: This practice is key to the sensemaking in this unit. Students figure out that energy transfer happens during chemical reactions, and the type of substances reacting, and the amount and proportions of those substances, affect energy transfer. They apply these ideas to design, construct, and test a flameless heater system that can be used to heat food in an emergency. They undertake this design project and engage in the design cycle to construct a homemade flameless heater and instructions for users that meet specific design criteria and constraints. Throughout the unit students work to optimize performance of their flameless heater by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Disciplinary Core Ideas (DCI)

- Some chemical reactions release energy, others store energy. (PS1.B.)

- Developing Possible Solution A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions. (ETS1.B.)

- Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (ETS1.C.)

Crosscutting Concepts (CCC)

- **Systems and System Models** - Models can be used to represent systems and their interactions— such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1), (MS-PS2-4), (MS-ESS1-2)

- **Energy and Matter** - Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.
9.4.8.DC.1	Analyze the resource citations in online materials for proper use.	Detailed examples exist to illustrate crediting others when incorporating

9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	their digital artifacts in one's own work.
9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

Central Idea/Enduring Understanding:

- How can we heat up food when we don't have our typical methods available?
- How do heaters get warm without a flame?
- What other chemical reactions could we use to heat up food?
- How much of each reactant should we include in our homemade flameless heater?
- How can we refine our criteria and constraints?
- How can we redesign our homemade flameless heater?
- How did our design compare to others in the class?
- What effects might result from our design changes?
- What is our optimal design for a homemade flameless heater?
- How can we decide between competing designs?

Essential/Guiding Question:

How can we use chemical reactions to design a solution to a problem?

Content:

Open Sci Ed: Chemical Reactions and Energy Lesson 1-10

Lesson 1 Phenomena/Design Problem:
The flameless heater in a Meal, Ready-to-Eat heats food when water is added.

Skills(Objectives):

- Ask questions that arise from careful observation of a flameless heater that is able to heat food (effect) using a chemical process (cause).
- Define a design problem that can be solved through the development of a homemade flameless heater with

Science 8

Lesson 2 Phenomena/Design Problem: The temperature increases when substances in air-activated hand warmers and flameless heaters are undergoing a chemical reaction. Lesson 3 Phenomena/Design Problem: Different chemical reactions cause an increase, decrease, or no change in temperature. Changing the amount of reactants changes the amount of energy transferred and warming more food requires more energy transfer. Lesson 4 Phenomena/Design Problem: Adjusting the proportion of reactants causes different temperature changes and different levels of leftover reactants and products. Lesson 5 Phenomena/Design Problem: The class seems to be repeating some of the work they are doing as engineers. Lesson 6 Phenomena/Design Problem: Copper sulfate and aluminum in saltwater can be used in a homemade device to heat up food. Lesson 7 Phenomena/Design Problem: Sharing designs among teams helps to determine which flameless heater design characteristics are more promising than others with respect to the identified criteria and constraints. Lesson 8 Phenomena/Design Problem: When a change is made to a design, there are downstream consequences of varying degrees that may result in different effects on stakeholders Lesson 9 Phenomena/Design Problem: Test results inform the redesign of our homemade flameless heater. Lesson 10 Phenomena/Design Problem Sea turtle populations in Australia are now over 99% female.	multiple criteria and constraints that uses a chemical process (system 1) to heat up food (system 2). ● Apply scientific ideas to design a solution for a flameless heater that heats food by a chemical process that transfers energy ● Conduct an investigation to serve as the basis for evidence to confirm that the devices are undergoing a chemical reaction when the temperature increases as energy is transferred from the substances in the devices to its surroundings (what the thermometer measures). ● Develop a model to describe how energy is transferred between different parts of our reaction system to inform the next steps of the design process. ● Collect data that support choosing the chemical reaction that can transfer the most energy to the food system. ● Develop a model to describe and/or explain the unobservable mechanism related to chemical reactions and the flow of energy to or from the reaction system and its surroundings. ● Evaluate and use accurate methods of data collection to define an optimal proportion of reactants that result in the greatest temperature change and least amount of reactants left over. ● Analyze data to identify patterns in numerical relationships and images to define an optimal proportion of reactants that result in the greatest temperature change and least amount of reactants left over. ● Analyze data by identifying patterns to define an optimal operational range for our homemade flameless heater designs that best meets criteria for success because the more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. ● Undertake a design project to construct and test a solution that meets specific design criteria and constraints, including the transfer of energy. ● Apply scientific ideas, results from testing designs, and the interactions identified on system models to modify our designs in order to improve the flow of energy to food. ● Respectfully provide and receive critiques about design solutions to evaluate competing designs with respect to how they meet criteria and constraints and consider patterns across multiple designs to determine which design characteristics caused more-effective outcomes in performance. ● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria using systematic processes to consider how small changes

	in one design characteristic might cause unexpected changes in other design characteristics. ● Prioritize criteria and consider trade-offs that occur as a result of design changes to decide which changes to incorporate for the optimal homemade heater design ● Communicate technical information in writing about how to transfer energy through a system that was designed to perform better than any of its predecessors by using parts of different solutions. ● Optimize performance of a design that represents systems and energy flows between systems by ● revising and retesting to incorporate characteristics of the most promising solutions. ● Make a written argument that supports or refutes the advertised performance of a sea turtle incubator based on evidence concerning whether the incubator meets relevant criteria and constraints, such as transferring the right amount of energy to the sea turtle eggs. ● Apply the Energy Transfer Model to show how the energy is transferred between the reaction occuring in the heat pack and the system containing the turtle eggs.

Interdisciplinary Connections:
ELA/Literacy -NJSLS

W.WR.8.5. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text

RI.CT.8.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) two or more informational texts that provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation.

SL.UM.8.5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Mathematics -NJSLS

MP.2 Reason abstractly and quantitatively.

7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

Stage 2: Assessment Evidence

Performance Task(s):	Other Evidence:
● **Dry Ice Model** - Evaluate a model of dry ice becoming a gas to determine if it explains that a chemical reaction produces a new substance and conserves atoms.	Do Nows Classwork Interactive Notebook Class discussions

https://authoring.concord.org/activities/5194/ccc16558-dd88-4b74-b00b-baa574529a9d ● **Propane burning in camp stove** - Use a model to explain how a chemical reaction occurs when propane is burned in a camp stove and how mass is conserved. https://authoring.concord.org/activities/5236/36f8ff59-2815-488f-8adc-9af3498983be ● **Forming a pesticide** - Draw a model to explain how two gasses react to form a common pesticide and how mass is conserved during the reaction. https://authoring.concord.org/activities/5245/7348acb0-13d6-4c88-9c92-703c88607994 ● **Photosynthesis according to Shawn** - Evaluate a model to determine if it explains how two new substances form and mass is conserved in the process of photosynthesis. https://authoring.concord.org/activities/5271/71d0699e-6326-4c11-b073-3d4be9029442 ● Unit Assessment in Edulastic	Closure activities (ex. exit tickets, kahoots, KWL charts) Personal digital responses (Kahoot, Quizizz, Quizlet, etc.) Homework Teacher observation Graphic Organizers Scientific inquiry analysis Common Formative Assessments Summative Unit Assessments
Stage 3: Learning Plan	
Learning Opportunities/Strategies: ● PhET: Bending Light https://phet.colorado.edu/en/simulation/bending-light ● What's the frequency, Roy G. Biv? https://imagine.gsfc.nasa.gov/educators/lessons/roygbiv/ Teaching Scientific Practices ● Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.) ● Students will utilize the engineering and design process to ask questions, plan and carry out investigations, refine models, design solutions, construct explanations, and design solutions. Literacies ● Use reading strategies to read non-fiction text (preview, question, reflect, highlight, recite, review, utilize text structure, etc.) ● Digital tools - utilize features available on ebooks such as highlighting, bookmarking, linking to more information, etc.	**Resources:** - Open SciEd - Get Ready to Read - Launch Labs - Content Vocabulary - MiniLabs - Content Practice worksheets - Math Skills - Enrichment - Challenge - Lesson Quizzes - Kessler Science - Labs - Key Concept Builder activities - Chapter Tests - Online quiz - Online Standardized Test Practice - YouTube videos - BrainPop videos - Flocabulary - Newsela - Readworks.org - Scholastic Science World magazine - Planet Earth "Caves" - Edulastic

- Digital literacy - Find and evaluate digital sources. Communicate clearly using digital platforms

Questioning - Present guiding leveled questions to students. See differentiation section for specific questions.

- Formative assessment response modalities
- Teacher/student question discussion
- Thumbs up/thumbs down
- Rate yourself on understanding on a fist to five scale
- Google Forms
- Digital polling devices (Kahoot, Quizizz, etc.)
- Exit tickets/responses
- Whiteboards

Learning Strategies

- Think, Pair, Share
- Direct instruction
- Jigsaw
- Cooperative groups
- Discussion in class and discussion boards
- Socratic Seminar

Learning Management

- Google Classroom - share information with students, post assignments, collect feedback
- Google Docs & Google Slides - creation and presentation tools

- NMSI
- IXL
- NGSS Phenomena: https://www.ngssphenomena.com

LGBT and Disabilities Resources:

- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:

- Learning for Justice
- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List
- Respect Ability: Fighting Stigmas, Advancing Opportunities
- NJDOE Diversity, Equity & Inclusion Educational Resources
- Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	**On Grade Level Students**	**Struggling Students**	**Special Needs/ELL**
Page Keeley Science Probes Interactive Science notebooks - higher level of Costa's questions created Scaffolded guiding questions - above level Less structure provided for assignments / assessments	Interactive Science notebooks Scaffolded guiding questions - on level Provide challenging tasks with support to allow students to experience success Moderate amount of scaffold on assignments	Interactive Science notebooks - templates provided by teacher Scaffolded guiding questions - below level Break down assignments into smaller tasks Structured, predictable classroom	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids

Heterogeneous grouping Research independently or collaboratively with minimal teacher guidance Laboratory investigations designed and carried out by students	Heterogeneous grouping Laboratory investigations designed by students with teacher assistance and carried out by students	Graphic organizers/Study guides provided Copy of class notes/presentation provided to student Utilize student's best personal learning modality (auditory, visual, kinesthetic) Heterogeneous grouping Laboratory investigations provided by teacher for students to carry out	Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit Title: **Unit 5: Contact Forces**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

MS-PS2-1: Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
MS-PS3-1: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Science and Engineering Practices (SEP)

- **Analyzing and Interpreting Data.** This unit intentionally develops this practice. Students work a new kind of mathematical relationship in their data analysis. Students construct, analyze, and interpret graphical displays to identify linear and nonlinear relationships and determine that the kinetic energy of a moving object is proportional to its mass and its kinetic energy is related to the square of its speed. Students also find lines of best fit and identify quantitative relationships in their data related to the amount of deformation per Newton of force and the change in Kinetic Energy as a scale factor.

The following practices are also key to the sensemaking in the unit:

- **Asking Questions and Identifying Problems Developing and Using Models.**
- **Planning and Carrying Out Investigations.**
- **Constructing Explanations and Designing Solutions Engaging in Arguments**

Disciplinary Core Ideas (DCI)

- PS2.A. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). In lesson 5, students figure out that the strength of the contact forces on each of two objects in contact with each other are equal and in opposite directions of each other. This idea is reused in lesson 6- 16.
- PS2.A. The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. In lesson 7-8, students explore how increasing the strength of a force applied from a spring scale launcher to a cart affects the speed of the cart when it is launched. They figure out that after increasing the mass of the cart a larger amount of force needed to be applied to it to get it to launch at the same speed. Students determine that when greater force is applied to a constant mass, the speed of the object will increase.Students then reuse this idea in lesson 10. Students investigate net force relationships in lesson 13 to compare the strength of multiple forces applied to multiple sides of a structure when that force is being compressed but not moving.
- PS2.A. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. Students are introduced to frames of reference in lesson 1, when they categorize all collisions that occur in any direction into one of three categories. Students identify a reference height to measure the deformation of an object in lesson 4 and compare different units for measuring the size of a force in lesson 5. They switch between measuring forces in different scales when they record peak forces in a collision in this lesson and also in subsequent lessons.
- PS3.A. Motion energy is properly called kinetic energy ; it is proportional to the mass of the moving object and grows with the square of its speed. Students recall their previous use of kinetic energy in the context of particle level collisions from the Cup Design Unit in lesson 2. In lesson 5 they identify the relative differences in kinetic energy for moving vs. non-moving carts with more or less mass or speed. In lesson 6 they gather data to determine that the kinetic energy of an object is proportional to its mass and that it grows with the square of its speed.
- PS2.A. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). In lesson 5, students figure out that the strength of the contact forces on each of two objects in contact with each other are equal and in opposite directions of each other. This idea is reused in lesson 6- 16. PS2.A. The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. In lesson 7-8, students explore how increasing the strength of a force applied from a spring scale launcher to a cart affects the speed of the cart when it is launched. They figure out that after increasing the mass of the cart a larger amount of force needed to be applied to it to get it to launch at the same speed. Students determine that when greater force is applied to a constant mass, the speed of the object will increase.Students then reuse this idea in lesson 10. Students investigate net force relationships in lesson 13 to compare the strength of multiple forces applied to multiple sides of a structure when that force is being compressed but not moving.

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Crosscutting Concepts (CCC)

- **Structure and function** This unit intentionally develops this crosscutting concept. Students develop the idea that complex microscopic structures and systems can be visualized, modeled, and used to analyze how their function depends on the relationships among its parts in Lesson Set 3, building and testing scaled up version of the space and air cavities found in many of the most effective cushioning materials. While students will have encountered parts of this idea in the Cup Design Unit, this unit is the first unit that has students develop larger scale modes of microscopic structures and test them to figure out why they function the way they do.

- **Stability and change.** This unit intentionally develops this crosscutting concept. This unit expands the scale that students consider for explanations of changes over time at different scales. Students consider forces on and within substructures that make up cushioning materials. Students also examine particle level force interactions due air resistance and surface friction to account for why the objects that were moving in a system (a cart and box) slow down, and eventually stop. The following practices are also key to the sensemaking in the unit: Patterns Cause and Effect Systems and System Models Energy and Matter

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.
9.4.8.DC.1	Analyze the resource citations in online materials for proper use.	Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.

9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	
9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

Central Idea/Enduring Understanding:

- What happens when two things hit each other?
- What causes changes in the motion and shape of colliding objects?
- Do all objects change shape or bend when they are pushed in a collision?
- How much do you have to push on any object to get it to deform (temporarily vs. permanently)?
- How does changing the mass or speed of a moving object before it collides with another object affect the forces on those objects during the collision?
- What have we figured out about objects interacting in collisions? How can we apply our new learning to answer questions about objects interacting in collisions?
- How much does doubling the speed or doubling the mass affect the kinetic energy of an object and the resulting damage that it can do in a collision?
- Where did the energy in our launcher system come from, and after the collisions where did it goto?
- How do other contact forces from interactions with the air and the track cause energy transfers in the launcher

Essential/Guiding Question:

Why do things sometimes get damaged when they hit each other?

system? ● Why do some objects break or not break in a collision? ● What can we design to better protect objects in a collision? ● What materials best reduce the peak forces in a collision? ● How (and why) does the structure of a cushioning material affect the peak forces produced in a collision? ● How can we use our science ideas and other societal wants and needs to refine our designs? ● How can we use what we figured out to evaluate another engineer's design?	
Content: **Open Sci Ed: Contact Forces Lessons 1-15** Lesson 1 Phenomena/Design Problem: Millions of phones are damaged a year in our country, and many of us have experienced such damage firsthand. We have a lot of experiences where a collision between two objects causes damage and also experiences where it surprisingly does not. Lesson 2 Phenomena/Design Problem: In collisions between different objects like balls, CD cases, rice noodles, wooden stirrers, crackers, and carts with metal hoops, rubber stoppers, and clay on them, the shape of the objects and/or their motion changes. Lesson 3 Phenomena/Design Problem: Cars, golf balls, baseball bats, and baseballs visibly bend and change shape during collisions. A piece of glass and concrete also bend when something else pushes on them. Lesson 4 Phenomena/Design Problem: All materials have an elastic limit and will deform and return to their original shape in response to an applied force up to a point, beyond which permanent deformation occurs. Lesson 5 Phenomena/Design Problem: When one of two objects (fingers or spring scales)	**Skills(Objectives):** ● Develop a model to describe interactions between two objects as they collide and show the changes that occur in the structure of both objects when one object is damaged as a result and also when neither object is damaged as a result. ● Ask questions that arise from observations of collisions between two objects in order to seek additional information about factors (causes) that might affect the outcome of such collisions. ● Collect data on changes in the motion and shape of colliding objects that serve as the basis for evidence that energy transfer occurs during the collision and that there are forces between colliding objects. ● Construct an argument supported by empirical evidence and scientific reasoning to support a model showing that changes in motion of colliding objects (connected to subsystems) results from energy transfer between them (cause) and changes in the shape of those objects results from force(s) between them (cause). ● Construct and revise a written argument using evidence from various sources of data (slow-motion videos, photos, and first hand investigations) to support or refute the claim that all objects do bend or change shape when pushed in a collision ● Plan an investigation, identifying controls to keep constant, and carry out the investigation to produce data to serve as the basis for evidence to develop a mathematical model for the relationship (pattern) between the amount of force applied to an object and the amount it deforms. ● Analyze and interpret graphical data (patterns) from tests of compression force vs. amount and type of deformation (temporary vs. permanent) to provide evidence that supports an argument that all objects

is pushed against another of these objects, both objects deform. The peak force registered on a spring scale is the same as the peak force registered on another spring scale when they make contact with each other (either through a static load or during a collision). Lesson 6 Phenomena/Design Problem: Soccer is becoming more and more popular in the United States. And while other soccer related injuries are happening less frequently, youth soccer players in the United States are experiencing more concussions. Lesson 7 Phenomena/Design Problem: Changes in the mass and speed of a cart affect how far it pushes a box down a track and the amount of damage it does to a cracker it runs into. Lesson 8 Phenomena/Design Problem: A phenomena from the previous lesson: Pulling back a cart against a push-pull spring scale and releasing it results in it launching the cart down a track, the cart running into a box, and the box getting pushed some distance down the track by the cart until both the cart and box stop moving. Lesson 9 Phenomena/Design Problem: An index card on the front of a cart visibly deforms when the cart coasts down the track; it deforms more when a faster headwind is blowing toward it; the cart doesn't travel as far and its direction of motion reverses in a headwind. Lesson 10 Phenomena/Design Problem: At each level of organized baseball, there are rules in place about what type of bat and ball can be used to ensure the game play remains competitive, fair, and fun. There are other factors that can impact game play that can't be controlled, such as weather conditions, location of the stadium, and the strength of the players. Lesson 11 Phenomena/Design Problem: All devices designed to protect objects have common criteria and constraints.	behave elastically up to a specific limit beyond which permanent damage occurs (stability and change). ● Plan and carry out an investigation and identify patterns in the data collected from the investigation to provide evidence that when peak contact forces on each object during the collision are equal in strength, the strength of those forces increases when the mass or the speed of the object that was moving before the collision increases. ● Develop and use subsystem models (free body diagrams) to represent how the peak contact forces on two different objects compare in a collision and how these are related to corresponding changes in the kinetic energy of a moving object before it collides due to a change in its mass or the speed. ● Apply science ideas and use evidence to construct an explanation for how the amounts of peak force and energy transfer (cause) in soccer collisions result in instability in the brain (concussions, effect) due to sudden changes at the cellular level. ● Construct, analyze, and interpret graphical displays of data collected from a computer simulation to identify patterns in the data, including a linear relationship between the mass of a moving object and its kinetic energy and its kinetic energy and a nonlinear relationship between the speed of a moving object and its kinetic energy. ● Construct an explanation based on quantitative relationships (scale) for whether decreasing the mass of a moving object or decreasing its speed would have a bigger effect on the peak forces produced in a collision between it and a stationary object and use these ideas to further explain why this would cause damage in some collisions but not others (effect). ● Develop and use a model to identify other parts of the system the cart and box are making contact with or colliding into that could be producing contact forces on these subsystems, causing energy to be transferred to or from them as the box and cart travel down the track.

Lesson 12 Phenomena/Design Problem: Materials that help to reduce peak force in a collision have similar structures, such as greater deformation abilities and air in their structures. Lesson 13 Phenomena/Design Problem: Cushioning material has repeating patterns of air or space gaps throughout its structure. Repeated chains of open-ring structures put between two colliding objects reduce the peak forces on those objects. Other changes in the arrangement of those structures also affect the forces applied to objects in the system. Lesson 14 Phenomena/Design Problem: When redesigning a device, stakeholder feedback is important to consider. Each change based upon a consideration comes with a trade-off, and those trade-offs have consequences for the usefulness and purpose of the device. Lesson 15 Phenomena/Design Problem: Cheerleading is a sport where the participants are at risk of concussions and traditionally haven't worn protective headgear. More recently, headgear from other sports has been used by some cheerleading squads to try to protect their members from injury. An opportunity exists to design a more customized form of headgear that better meets the needs of this particular sport.	

Interdisciplinary Connections:
ELA/Literacy -NJSLS

W.WR.8.5. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text

RI.CT.8.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) two or more informational texts that provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation.

SL.UM.8.5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Mathematics -NJSLS
MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.
7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert

between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
7.RP.A.2 Recognize and represent proportional relationships between quantities.
8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.
8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Stage 2: Assessment Evidence

Performance Task(s):

- Newton Comic Strip:
  Students will construct a comic strip displaying Newton's Laws of Motion and apply it to an everyday scenario.
  https://bclearningnetwork.com/LOR/projects/P11U03P04.pdf
- Seeing Motion:
  Students will measure, graph, and describe an object by its position, direction of motion, and speed.
  https://authoring.concord.org/activities/1071/single_page/585361dc-0d13-4756-80a2-5976be8eba06
- Sailboat design:
  Design and build a sailboat that can travel a specified distance. Compare distances traveled with natural wind vs. man-made wind (fan). Revise model based on observations. Retest until final product meets or exceeds required criteria.
  http://tryengineering.org/lessons/sailaway.pdf
- Cardboard Coaster Challenge
  https://docs.google.com/document/d/1qA5LQMWQ_RkPUaj5KG9s2hLb2TzLg1BReBTDTdnDr-M/edit?usp=sharing
- Catapults!
  https://www.teachengineering.org/activities/view/cub_mechanics_lesson04_activity1
- Design a Rube Goldberg Machine
  https://www.teachengineering.org/activities/view/rube_goldberg_machine

Other Evidence:

Do Nows
Classwork
Interactive Notebook
Class discussions
Closure activities (ex. exit tickets, kahoots, KWL charts)
Personal digital responses (Kahoot, Quizizz, Quizlet, etc.)
Homework
Teacher observation
Graphic Organizers
Scientific inquiry analysis
Common Formative Assessments
Summative Unit Assessments

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- Building towards: 2.B.2 Construct an argument supported by empirical evidence and scientific reasoning to support a model showing that changes in motion of colliding objects (connected to subsystems) result from energy transfer between them (cause) and changes in the shape of those objects result from force(s) between them (cause).
- Unit Assessment in Edulastic

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<tr><th colspan="2">Stage 3: Learning Plan</th></tr>
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Learning Opportunities/Strategies:

- Physics Tug-of-War https://www.teachengineering.org/activities/view/cub_airplanes_lesson03_activity2
- PhET Forces and Motion http://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html

Teaching Scientific Practices

- Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.)
- Students will utilize the engineering and design process to ask questions, plan and carry out investigations, refine models, design solutions, construct explanations, and design solutions.

Literacies

- Use reading strategies to read non-fiction text (preview, question, reflect, highlight, recite, review, utilize text structure, etc.)
- Digital tools - utilize features available on ebooks such as highlighting, bookmarking, linking to more information, etc.
- Digital literacy - Find and evaluate digital sources. Communicate clearly using digital platforms

Questioning - Present guiding leveled questions to students. See differentiation section for specific questions.

- Formative assessment response modalities
- Teacher/student question discussion
- Thumbs up/thumbs down

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Resources:

- Open SciEd
- Get Ready to Read
- Launch Labs
- Content Vocabulary
- MiniLabs
- Content Practice worksheets
- Math Skills
- Enrichment
- Challenge
- Lesson Quizzes
- Kessler Science
- Labs
- Key Concept Builder activities
- Chapter Tests
- Online quiz
- Online Standardized Test Practice
- YouTube videos
- BrainPop videos
- Flocabulary
- Newsela
- Readworks.org
- Scholastic Science World magazine
- Planet Earth “Caves”
- Edulastic
- IXL
- NMSI
- NGSS Phenomena: https://www.ngssphenomena.com

LGBT and Disabilities Resources:

- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:

- Learning for Justice
- GLSEN Educator Resources

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• Rate yourself on understanding on a fist to five scale • Google Forms • Digital polling devices (Kahoot, Quizizz, etc.) • Exit tickets/responses • Whiteboards Learning Strategies • Think, Pair, Share • Direct instruction • Jigsaw • Cooperative groups • Discussion in class and discussion boards • Socratic Seminar Learning Management • Google Classroom - share information with students, post assignments, collect feedback • Google Docs & Google Slides - creation and presentation tools	• Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Page Keeley Science Probes Interactive Science notebooks - higher level of Costa's questions created Scaffolded guiding questions - above level Less structure provided for assignments / assessments Heterogeneous grouping Research independently or collaboratively with minimal teacher guidance Laboratory investigations designed and carried out by students	Interactive Science notebooks Scaffolded guiding questions - on level Provide challenging tasks with support to allow students to experience success Moderate amount of scaffold on assignments Heterogeneous grouping Laboratory investigations designed by students with teacher assistance and carried out by students	Interactive Science notebooks - templates provided by teacher Scaffolded guiding questions - below level Break down assignments into smaller tasks Structured, predictable classroom Graphic organizers/Study guides provided Copy of class notes/presentation provided to student Utilize student's best personal learning	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

		modality (auditory, visual, kinesthetic) Heterogeneous grouping Laboratory investigations provided by teacher for students to carry out	

Unit Title: **Unit 6: Sound Waves**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-LS1-8.* Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Science and Engineering Practices (SEP)

- **Using Mathematics and Computational Thinking:** This unit intentionally develops this practice. Mathematical reasoning is key to figuring out the phenomena throughout the unit. The development and analysis of mathematical representations plays a central role in student sensemaking. Lessons 4-6 involve students in novel uses of math representations when they work with the teacher to figure out how to develop and experiment with a scaled up version of the phenomena so they can analyze non visible motions of objects making sound. They represent an object's motion graphically and use these mathematical representations of position versus time graphs generated from the movement of an object making louder/softer and higher/lower pitch sounds to describe wave patterns (frequency and amplitude) and to figure out how objects making different sounds move. In lesson 10, students look at patterns in the rate of and spacing in between compression bands as a way to measure wavelengths depending on the initial frequency or amplitude.
- **Engaging in Argument from Evidence:** This practice is key to the sensemaking students do in this unit. Students construct written and oral arguments throughout Lesson Sets 1 and 2. Students construct arguments from evidence about whether all objects vibrate when they make sounds; to support an explanation for which patterns of frequency and amplitude of a wave are related to sounds that we can hear; and whether matter is traveling all the way from the speaker to the window. They compare claims about whether air is needed for sound to travel to where we can hear it and use evidence from their investigations to select and defend one of these claims. Students provide critiques about their classmates' explanations and

models and respond to those critiques by citing relevant evidence from their investigations and revising their explanations and models.

- **Developing and Using Models**: This practice is key to the sensemaking students do in this unit. Although no new elements of this practice are introduced, students use models to make sense of and explain almost every aspect of what they figure out in this unit. Students have frequent opportunities to develop and revise models with a partner, in small groups, or as a class when they are making sense of new science ideas.

Disciplinary Core Ideas (DCI)

- PS4.A: Wave Properties A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. A sound wave needs a medium through which it is transmitted. By investigating factors including loudness and pitch, students develop a model of vibration that captures important ideas about how changes in the frequency and amplitude of the vibrations can explain these different characteristics of sounds. Students use this model of vibration to answer their initial questions about what causes different sounds. By testing various types of materials and using interactive computer models, students figure out how sound travels from one location to another by causing sequences of vibrations through matter. What they figure out helps students answer their initial questions about h
- LS1-D: Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. In order to find answers to their questions about how our ears detect sounds, students read an interview with experts and watch several videos and animations about the structures of the ear and how hearing loss can occur. They synthesize that information to annotate a model showing how energy is transferred through the parts of the ear to the nerve cells that send signals to the brain. Other aspects of this PE are developed in additional OpenSciEd units, beginning their initial work on
- MS-LS1-8 in the One-way Mirror Unit with figuring out our eyes have receptors that send signals to our brain; the Healing Unit primarily addresses the role of nerve cells in sending signals to the brain. In the Bath Bombs Unit students figure out our body has receptors in our nose that send information to our brain to help us identify different odors. In the Collisions Unit, students figure out there are receptors in our skin that send signals to our brain.

Crosscutting Concepts (CCC)

- **Scale, Proportion, and Quantity:** This unit intentionally develops this crosscutting concept. Students extend their understanding of phenomena happening at scales we cannot see by using a variety of tools to model and collect data about the vibrations that occur when objects make sounds, and how those sounds transfer energy across media. Lessons 4-6 involve students in novel uses of scale when they work with the teacher to figure out how to develop and experiment with a scaled up version of the phenomena so they can analyze non visible motions of objects making sound. They use the representations developed from using this scaled up object to explain how different sounds are produced. Additionally, students evaluate or help propose other ways of scaling objects throughout the unit in order to provide evidence of what is happening when sounds are made (e.g. slow-motion videos of instruments in lesson 2, laser in lesson 3, simulation in lesson 10). In lesson 13 students use proportional relationships to analyze information from numerical data and graphs of how the energy transferred by a vibration chang
- **Patterns:** This crosscutting concept is key to the sensemaking in this unit. In Lessons 1-3 students begin by using patterns to identify cause and effect relationships about sound sources. In Lessons 4-6 they compare and contrast graphical representations of objects moving and identify patterns about how sound makers vibrate differently for low/high pitched or loud/soft sounds. In Lesson 8 students notice patterns across investigations that sounds can be heard when there is matter between them and the sound source and use

this pattern to identify that matter is needed for sounds to travel. In Lesson 10 they measure visual patterns in rate change of compression bands to see how changes in frequency and amplitude at the sound source affect the rate of movement of matter in the system. In Lesson 13 they use charts and graphs to identify patterns in rates of change as they discover that energy is transferred differently for increases in frequency versus amplitude of vibrations.

- **Energy and Matter:** This crosscutting concept is key to the sensemaking in this unit. Students use what they figured out about energy transfer in prior units to figure out how the transfer of energy from a force causes a sound source to vibrate (lessons 2-6) which transfers energy to neighboring particles across a medium, and those particles collide with another object, transferring energy to make it move (lessons 7-14). Students track the transfer of energy

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.
9.4.8.DC.1	Analyze the resource citations in online materials for proper use.	Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.
9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	
9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

Science 8

Central Idea/Enduring Understanding:	Essential/Guiding Question:
• Lesson 1: How does a sound source make something like this happen? • What is happening when speakers and other music makers make sounds? • Do all objects vibrate when they make sounds? • How do the vibrations of the sound source compare for louder versus softer sounds? • How do the vibrations from a sound source compare for higher-pitch versus lower-pitch sounds? • How can any object make so many different sounds? • What is actually moving from the sound source to the window? • Do we need air to hear sound? • How can we model sound traveling through a solid, liquid, or gas? • What exactly is traveling across the medium? • How does sound make matter around us move? • What goes on in people's ears so they can detect certain sounds? • What transfers more energy, waves of bigger amplitude or waves of greater frequency? • How can we explain our anchoring phenomenon, and which of our questions can we now answer?	How can a sound make something move?
Content: **Open Sci Ed: Sound Waves Lessons 1-14** Lesson 1 Phenomena/Design Problem: Loud music from a truck makes a window in the parking lot move. A speaker moved when it produced sound. Lesson 2 Phenomena/Design Problem: Musical instruments and speakers vibrate (move back and forth) when a force is applied. Lesson 3 Phenomena/Design Problem: A laser directed at a mirror on a drum, table, and	**Skills(Objectives):** • Develop an initial model to describe how interactions between parts of a speaker system (magnet and coil of wire) cause sound without those parts touching each other. • Ask questions about how interactions between parts of a speaker system (magnet and coil of wire) cause sound without those parts touching each other. • Analyze and interpret data to identify patterns in the data that provide evidence of the relationship between a force (cause) on an instrument and the motion/vibration (effect) of the instrument. • Develop a model to describe how a force applied to an instrument causes its shape to change, leading it to repeatedly deform above and below its initial position

speaker lets us better see the vibrations that happen when those objects make sounds. Lesson 4 Phenomena/Design Problem: Motion graphs of louder sounds have higher amplitude, and softer sounds have lower amplitude, but the number of vibrations of the stick per second (we called this frequency) didn't change whether we deformed the stick more or less. Lesson 5 Phenomena/Design Problem: A shorter stick vibrates faster than the longer stick, and the graph of the motion of the speaker also shows faster vibrations for higher pitch. Lesson 6 Phenomena/Design Problem: A video and graphs of the motion of a harp making sounds are used to model and argue for the different sounds being made. Lesson 7 Phenomena/Design Problem: By placing a sound maker in a sealed container, we observe that we can still hear sounds coming from inside and that the mass of the container does not change before and after sounds are played. Lesson 8 Phenomena/Design Problem: When a sound source is placed in a solid container with liquid or gas inside, we hear sounds coming from inside. When it is placed in a container with no matter inside, we do not hear any sounds coming from inside. Lesson 9 Phenomena/Design Problem: We use our bodies to simulate a sound source hitting a particle, causing it to collide into the particle next to it, transferring energy to the next particle and so on. Lesson 10 Phenomena/Design Problem: Vibrations of a sound source cause particle bands to push against the particles next to them, creating dark and light bands where there are areas of densely and loosely packed particles. Lesson 11 Phenomena/Design Problem: Salt on plastic wrap stretched over a bowl jumps up	(effect) as it vibrates and use that model to predict what a force will do to another instrument. ● Engage in argument from evidence to support or refute our predictions about whether all solid objects vibrate (cause) when they make sounds (effect), even when we cannot see them vibrate. ● Use mathematical representations of position versus time graphs generated from a tool used to scale up the vibrations of an object to describe wave patterns and support scientific conclusions about how objects move when they make louder or softer sounds.

and down when a drum nearby is hit. Lesson 12 Phenomena/Design Problem: An otoscope video of an eardrum examination, an animated diagram, and a reading show the structures in the ear canal and vibrations entering the inner ear. Lesson 13 Phenomena/Design Problem: A ruler (representing a vibrating object) pushes marbles (representing nearby particles) with greater energy when we increase the amplitude or frequency of the ruler's vibrations. Increasing amplitude has a proportionally greater effect on energy transfer than increasing frequency. Lesson 14 Phenomena/Design Problem: Hitting a cymbal loudly can damage a musician's ears.	

Interdisciplinary Connections:

SL.UM.8.5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

W.SE.8.6. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation

Mathematics -NJSLS
MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.
6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
7.RP.A.2 Recognize and represent proportional relationships between quantities.
8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Stage 2: Assessment Evidence

Performance Task(s):	**Other Evidence:**
• Sound and Ocean Waves https://betterlesson.com/lesson/645430/sound-waves-and-ocean-waves • Conduct two investigations to measure "What transfers more energy, waves of bigger amplitude or waves of greater frequency?" First, we change how many times a marker representing the sound detector is hit by marbles in a given time	Do Nows Classwork Interactive Notebook Class discussions Closure activities (ex. exit tickets, kahoots, KWL charts) Personal digital responses (Kahoot, Quizizz, Quizlet, etc.) Homework Teacher observation Graphic Organizers Scientific inquiry analysis Common Formative Assessments

period (the frequency) and measure the total distance the marker moved (the amount of energy transferred to the detector). Next, we change the force acting upon the marbles (changing the amplitude) and measure how this changes the distance the marker moves. • Unit Assessment Lesson 14 in OpenSci Ed	Summative Unit Assessments
Stage 3: Learning Plan	
Learning Opportunities/Strategies: Teaching Scientific Practices - Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.) - Students will utilize the engineering and design process to ask questions, plan and carry out investigations, refine models, design solutions, construct explanations, and design solutions. Literacies - Use reading strategies to read non-fiction text (preview, question, reflect, highlight, recite, review, utilize text structure, etc.) - Digital tools - utilize features available on ebooks such as highlighting, bookmarking, linking to more information, etc. - Digital literacy - Find and evaluate digital sources. Communicate clearly using digital platforms Questioning - Present guiding leveled questions to students. See differentiation section for specific questions. Test the Turn It Up! speaker simulation at https://openscied.org/turn-it-up/ to make sure it plays Questioning - Present guiding leveled questions to students. See differentiation section for specific questions. • Formative assessment response modalities • Teacher/student question discussion • Thumbs up/thumbs down • Rate yourself on understanding on a fist to five scale • Google Forms • Digital polling devices (Kahoot, Quizizz, etc.) • Exit tickets/responses	**Resources:** - Open SciEd - Get Ready to Read - Launch Labs - Content Vocabulary - MiniLabs - Content Practice worksheets - Math Skills - Enrichment - Challenge - Lesson Quizzes - Kessler Science - Labs - Key Concept Builder activities - Chapter Tests - Online quiz - Online Standardized Test Practice - YouTube videos - BrainPop videos - Flocabulary - Newsela - Readworks.org - Scholastic Science World magazine - Planet Earth “Caves” - Edulastic - IXL - NMSI - NGSS Phenomena: LGBT and Disabilities Resources: • LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books DEI Resources: • Learning for Justice • GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities

● Whiteboards Learning Strategies ● Think, Pair, Share ● Direct instruction ● Jigsaw ● Cooperative groups ● Discussion in class and discussion boards ● Socratic Seminar Learning Management ● Google Classroom - share information with students, post assignments, collect feedback ● Google Docs & Google Slides - creation and presentation tools	● NJDOE Diversity, Equity & Inclusion Educational Resources ● Diversity Calendar

Differentiation
*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Page Keeley Science Probes Interactive Science notebooks - higher level of Costa's questions created Scaffolded guiding questions - above level Less structure provided for assignments/assessments Heterogeneous grouping Research independently or collaboratively with minimal teacher guidance Laboratory investigations designed and carried out by students	Interactive Science notebooks Scaffolded guiding questions - on level Provide challenging tasks with support to allow students to experience success Moderate amount of scaffold on assignments Heterogeneous grouping Laboratory investigations designed by students with teacher assistance and carried out by students	Interactive Science notebooks - templates provided by teacher Scaffolded guiding questions - below level Break down assignments into smaller tasks Structured, predictable classroom Graphic organizers/Study guides provided Copy of class notes/presentation provided to student Utilize student's best personal learning modality (auditory, visual, kinesthetic) Heterogeneous grouping	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

		Laboratory investigations provided by teacher for students to carry out	

Unit Title: **Unit 7: Forces at a Distance**

Stage 1: Desired Results

Standards & Indicators:

NJSLS for Science

- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

- MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

- MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Science and Engineering Practices (SEP)

- **MathAsking Questions and Defining Problems:** This unit intentionally develops students' engagement in this practice through the use of sentence frames to help them ask investigable questions about specific cause and effect relationships, and to construct scientific hypotheses from these questions that include a mechanistic account of an observable relationship between variables.
- **Planning and Carrying Out Investigation:** This unit intentionally develops students' engagement in this practice. Students use hypothesis-building cause-effect sentence frames to identify variables they need to test to evaluate their hypothesis. In Lessons 10-11, students plan and conduct an investigation collaboratively as a class and in small groups to produce data to serve as the basis for evidence for describing cause and effect relationships between factors in a speaker system.
- **Developing and Using Models:** This practice is key to the sensemaking in this unit. Students develop and use models throughout the unit to try to explain how some parts of the speaker are moving without being in contact with the rest of the system, beginning in Lesson 1. They use their models to test cause and effect relationships to describe how the speaker works.
- **Analyzing and Interpreting Data, and Using Mathematics and Computational Thinking are also key to the sensemaking** in this unit. In Lessons 10-11, students analyze data from their investigations in order to identify and describe the nonlinear relationships between various factors and magnetic force.

Disciplinary Core Ideas (DCI)

- PS2.B: Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). In the first lesson set (Lessons 1-6) students develop and use a model of magnetic fields in order to explain how magnets and wires inside of a speaker interact through forces at a distance to produce vibration and, therefore, sound.
- PS3.A: A system of objects may also contain stored (potential) energy, depending on their relative positions. In Lesson 3, students begin to consider energy as a factor in the system. In Lesson 7, students plan and

carry out an investigation using a cart on a track to explain how changing the distance between two magnets affects the amount of energy transferred into and out of the magnetic field.

- PS3.C: When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. In Lesson 9, students obtain evidence from their investigations in Lesson Set 2, and a set of readings that the current in the electromagnet will alternately produce force pairs between the magnet and the coil of wire that push them apart (repulsive force) and pull them together (attractive force). Energy is thus transferred into the magnetic field by the electric current flowing through the electromagnet and stored until it is converted into kinetic energy that transfers out of the system as sound energy.
- PS2.B: Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. In Lesson 2, students experiment with magnets, coils and other metal objects to establish both pushes and pulls (repulsive and attractive forces) between magnets and electromagnets. In the last lesson set (Lessons 10-12), students design a set of investigations to modify various parts of the system in order to increase the forces in the magnetic field. These include increasing the current in an electromagnet, increasing the number of coils, increasing the number of permanent magnets, decreasing the distance between the magnet and the test object, and increasing the diameter of the magnets.

Crosscutting Concepts (CCC)

- **Cause and Effect:** This unit intentionally develops this crosscutting concept through the application of cause-effect sentence frames. Students routinely identify, test, and use relationships to explain change throughout.
- **Systems and System Models:** This crosscutting concept is key to the sensemaking in this unit.Students spend the unit breaking down and modeling the speaker system, describing and explaining the system in terms of its components and interactions
- **Energy and Matter:** This crosscutting concept is key to the sensemaking in this unit. Students figure out and apply the idea that energy can be transferred in various ways and between objects in order to explain how the speaker system works**.**

The following crosscutting concepts are also key to the sensemaking in this unit:

- **Patterns**
- **Scale, Proportion, and Quantity**

Career Readiness, Life Literacies and Key Skills		
Standard	**Performance Expectations**	**Core Ideas**
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).	Multiple solutions often exist to solve a problem.

9.4.8.DC.1	Analyze the resource citations in online materials for proper use.	Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.
9.4.8.DC.2	Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).	
9.4.8.DC.7	Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.	Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.
9.4.8.DC.8	Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).	Digital technology and data can be leveraged by communities to address effects of climate change.
9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).	Sources of information are evaluated for accuracy and relevance when considering the use of information.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.	

Central Idea/Enduring Understanding:

- What can a magnet pull or push without touching?
- How does energy transfer between things that are not touching?
- What can we figure out about the invisible space around a magnet?
- How does the magnetic field change when we add another magnet to the system?
- How can we use magnetic fields to explain interactions at a distance between the magnet and the coil?
- How does changing the distance between two magnets affect the amount of energy transferred out of the field?
- How does the energy transferred from a battery to a wire coil compare to the energy transferred from a computer to a speaker?
- How do the magnet and the electromagnet work together to move the speaker?
- How does distance affect the strength of force pairs in a magnetic field?

Essential/Guiding Question:

How can a magnet move another object without touching it?

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● What else determines the strength of the force pairs between two magnets in a magnetic field? ● What cause-effect relationships explain how magnetic forces at a distance make things work?	
Content: **Open Sci Ed: Forces at a Distance Lessons 1-12** Lesson 1 Phenomena/Design Problem: A speaker system with a magnet and a coil of wire moves back and forth without the parts touching. Lesson 2 Phenomena/Design Problem: A magnet interacts with metal but not with copper unless it is connected to a battery. Lesson 3 Phenomena/Design Problem: When we block the air between two magnets or remove it altogether, magnets still exhibit the same interactions when they get close to each other. Lesson 4 Phenomena/Design Problem: When we place test objects like iron filings or compasses near a magnet we see patterns in the direction that they move that we can model with diagrams and computer interactives. Lesson 5 Phenomena/Design Problem: When we add a second magnet to the computer interactive, the shape of the magnetic field changes depending on the orientation of the magnets to one another. Lesson 6 Phenomena/Design Problem: In a speaker, forces transfer energy out of an invisible magnetic field and into the rest of the system, producing the movement that we observe as vibrations or sound. Lesson 7 Phenomena/Design Problem: A cart on a track with a magnet on it is repelled by another magnet mounted to a bumper and moves away from the bumper magnet after the cart is brought near it and then released. Lesson 8 Phenomena/Design Problem: A speaker, a wire coil, an incandescent lightbulb, and a bicolor LED respond to an electric current provided by a battery vs. a sound app on a computer in some ways that are similar and some ways that are different.	**Skills(Objectives):** ● Collect data to establish that magnets interact with certain objects to cause paired forces that are either attractive (both pulls) or repulsive (both pushes) and that changing the orientation of either of the magnets will cause both forces to reverse direction. ● Collect data to answer questions about the coil of wire and provide evidence to support the claim that connecting the coil of wire to a battery causes the same paired forces between the coil and a magnet as between two magnets. ● Develop and test a set of hypotheses to produce evidence that energy can transfer between magnets without transferring through matter, causing the magnets to move. ● Construct an argument supported by empirical evidence and scientific reasoning that energy can transfer between magnets without going through matter, causing the magnets to move. ● Ask questions about the cause and effect relationships that produce the patterns we observed (and will observe) in the direction or size of forces in a magnetic field around a permanent magnet as it interacts with another object(s) near it. ● Use diagrams and simulations to model the patterns we observe in the forces experienced by test objects placed near a magnet or a coil of wire connected to a battery (magnetic fields). Use a computer interactive to model the effect on the patterns in the magnetic field when we add an electromagnet to the single magnet system. ● Develop an initial model to describe how forces and energy transfer in magnetic fields explain cause and effect relationships between parts of a speaker system (magnet and coil of wire). ● Ask questions about how interactions between parts of a speaker system (magnet and coil of wire) cause sound without those parts touching each other.

Lesson 9 Phenomena/Design Problem: In a speaker, forces transfer energy out of an invisible magnetic field into the rest of the system, producing the movement that we observe as vibrations or sound. Lesson 10 Phenomena/Design Problem: When we change the distance between two magnets, the force pairs between them (attractive or repulsive) get stronger when they are closer together. Lesson 11 Phenomena/Design Problem: When we increase the size of a permanent magnet, increase the number of coils in an electromagnet, or increase the current in an electromagnet, we make the forces between magnets stronger. Lesson 12 Phenomena/Design Problem: In a speaker, forces transfer energy out of an invisible magnetic field into the rest of the system, producing the movement that we observe as vibrations or sound.	

Interdisciplinary Connections:
ELA/Literacy -NJSLS

W.WR.8.5. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text

Mathematics -NJSLS
MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.

Stage 2: Assessment Evidence

Performance Task(s):	Other Evidence:
• Seeing Motion: Students will measure, graph, and describe an object by its position, direction of motion, and speed.https://authoring.concord.org/activities/1071/single_page/585361dc-0d13-4756-80a2-5976be8eba06 • Unit Assessment Lesson 14 in OpenSci Ed	Do Nows Classwork Interactive Notebook Class discussions Closure activities (ex. exit tickets, kahoots, KWL charts) Personal digital responses (Kahoot, Quizizz, Quizlet, etc.) Homework Teacher observation Graphic Organizers Scientific inquiry analysis Common Formative Assessments Summative Unit Assessments

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Stage 3: Learning Plan	
Learning Opportunities/Strategies: Teaching Scientific Practices - Guide students through appropriate laboratory techniques (safety, accuracy, frequency, data collection, etc.) - Students will utilize the engineering and design process to ask questions, plan and carry out investigations, refine models, design solutions, construct explanations, and design solutions. Literacies - Use reading strategies to read non-fiction text (preview, question, reflect, highlight, recite, review, utilize text structure, etc.) - Digital tools - utilize features available on ebooks such as highlighting, bookmarking, linking to more information, etc. - Digital literacy - Find and evaluate digital sources. Communicate clearly using digital platforms Questioning - Present guiding leveled questions to students. See differentiation section for specific questions. Questioning - Present guiding leveled questions to students. See differentiation section for specific questions. ● Formative assessment response modalities ● Teacher/student question discussion ● Thumbs up/thumbs down ● Rate yourself on understanding on a fist to five scale ● Google Forms ● Digital polling devices (Kahoot, Quizizz, etc.) ● Exit tickets/responses ● Whiteboards Learning Strategies ● Think, Pair, Share ● Direct instruction ● Jigsaw ● Cooperative groups ● Discussion in class and discussion boards ● Socratic Seminar Learning Management ● Google Classroom - share information with students, post assignments, collect feedback ● Google Docs & Google Slides - creation and presentation tools	**Resources:** - Open SciEd - Get Ready to Read - Launch Labs - Content Vocabulary - MiniLabs - Content Practice worksheets - Math Skills - Enrichment - Challenge - Lesson Quizzes - Kessler Science - Labs - Key Concept Builder activities - Chapter Tests - Online quiz - Online Standardized Test Practice - YouTube videos - BrainPop videos - Flocabulary - Newsela - Readworks.org - Scholastic Science World magazine - Planet Earth "Caves" - Edulastic - IXL - NMSI - NGSS Phenomena: LGBT and Disabilities Resources: ● LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth ● LGBTQ+ Books DEI Resources: ● Learning for Justice ● GLSEN Educator Resources ● Supporting LGBTQIA Youth Resource List ● Respect Ability: Fighting Stigmas, Advancing Opportunities ● NJDOE Diversity, Equity & Inclusion Educational Resources ● Diversity Calendar

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Differentiation *Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation			
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Pacing Guide
(90 days)

Course Name	Content/Resources (OpenSciEd)	Standards
UNIT: Energy (22 days)		
Unit 1 Light and Matter (10 days) Unit 2 Thermal Energy (12 days) Unit 6 Sound Energy (10 days)	OpenSciEd Unit 6.1 OpenSciEd Unit 6.2 OpenSciEd Unit 8.2	**MS-PS4-2** **MS-LS1-8** **MS-PS1-4** **MS-PS3-3** **MS-PS3-4** **MS-PS3-5** **MS-PS4-2** **MS-ETS1-4** **MS-PS4-1** **MS-PS4-2** **MS-LS1-8**
UNIT: Chemical Reactions (24 days)		
Unit 3: Chemical Reactions/Matter (12 days) Unit 4: Chemical Reactions/Energy (12 days)	OpenSciEd Unit 7.1 OpenSciEd Unit 7.2	**MS-PS1-1** **MS-PS1-2** **MS-PS1-5** **MS-LS1-8** **MS-PS1-6** **MS-ETS1-2** **MS-ETS1-3** **MS-ETS1-4**
UNIT: Forces (20 days)		
Unit 5: Contact forces (20 days)	OpenSciEd Unit 8.1	**MS-PS2-1** **MS-PS2-2** **MS-PS3-1** **MS-LS1-8** **MS-ETS1-2** **MS-ETS1-3**
UNIT: Forces at a distance (20 days)		
Unit 7: Forces at a distance (20 days)	OpenSciEd Unit 8.3	**MS-PS 2-3** **MS-PS 3-2** **MS-PS2-5**