West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 4 - Earth Processes

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.

Unit 2: Earth Processes	
Content Area: Science	
Course & Grade Level: Grade 4	
Summary and Rationale	
In this unit of study, students apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. The crosscutting concepts of *patterns*, *cause and effect*, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.	
Recommended Pacing	
9 days	
New Jersey Student Learning Standards for	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
CPI #	**Cumulative Progress Indicator (CPI)**
4-ESS2-2	**Analyze and interpret data from maps to describe patterns of Earth's features.** *[Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]*
4-ESS3-2	**Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** *[Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.]* [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.*]*
3-5-ETS1-2	**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**
3-5-ETS1-3	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
Standard: NJSLS-S K-12 Climate Change Standards	
CPI #	**Cumulative Progress Indicator (CPI)**
4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes and climate change have on humans.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**
RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)

RI.4.7	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic (4-ESS2-2)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.1.5.RMI.1	Identify risks that individuals and households face.
9.4.5.CI.1	Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a)
9.4.5.CI.4	Research the development process of a product and identify the role of failure as a part of the creative process
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2)
9.4.5.CT.3	Describe how digital tools and technology may be used to solve problems
9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.5.F.1	Apply digital tools to collect, organize, and analyze data that support a scientific finding.
8.2.5.A.2 8.2.5.A.3 8.2.5.A.4 8.2.5.A.5	Investigate and present factors that influence the development and function of a product and a system. Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints. Compare and contrast how technologies have changed over time due to human needs and economic, political and/or cultural influences. Identify how improvement in the understanding of materials science impacts technologies.
8.2.5.C.1 8.2.5.C.2 8.2.5.C.3 8.2.5.C.4	Collaborate with peers to illustrate components of a designed system. Explain how specifications and limitations can be used to direct a product's development. Research how design modifications have lead to new products. Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models
8.2.5.D.1 8.2.5.D.2 8.2.5.D.6	Identify and collect information about a problem that can be solved by technology, generate ideas to solve the problem, and identify constraints and trade-offs to be considered. Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process to evaluate potential solutions. Explain the positive and negative effect of products and systems on humans, other species and the environment, and when the product or system should be used
Interdisciplinary Standards	

4.MD.A.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. 4-ESS2-2)
MP.2	Reason abstractly and quantitatively. (4-ESS3-2), (3-5-ETS1-2),(3-5-ETS1-3)
MP.4	Model with mathematics. (4-ESS3-2), (3-5-ETS1-2),(3-5-ETS1-3)
4.OA.A.1	Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2)
MP.5	Use appropriate tools strategically. (3-5-ETS1-2),(3-5-ETS1-3)
3-5.OA	Operations and Algebraic Thinking (3-ETS1-2)

Instructional Focus

Unit Enduring Understandings

- Natural Processes occur all over the world and may or may not affect human populations
- Seismic Natural Processes have a pattern to their occurrence and maps can help identify this pattern
- Human actively take steps to reduce the impact of natural disasters on human populations

Unit Essential Questions

- Is there a pattern to where certain natural disasters occur? (Limited to Earthquakes, Volcanoes, and Tsunamis)
- What impact do natural disasters have on human populations?
- How can scientists and engineers reduce the impact of natural disasters on human populations?

Objectives

Students will know:

- *The position and movement of tectonic plates directly correlates to the occurrence of seismic natural processes*
- *There are various tools that scientists and engineers use to detect, measure, and track natural Earth Processes*
- *Scientists and Engineers consider many aspects when building structures designed to resist the effect of Natural Disasters. This includes, but is not limited to: materials, structure shape, weight,, and various technologies specifically designed to mitigate the impact of disasters (dampeners, pendulums, etc.)*

Students will be able to:

- Students will generate a series of questions about earth processes (specifically volcanoes) and talk knowledgeably about describe Earth's elevation by performing a QFT and studying topographical maps
- Students will be able to discuss how volcanoes are measured by conducting research about the tools scientists use to study volcanoes.
- Students will learn about tools that scientists use to detect disasters to determine how such devices aid in protecting human populations.
- Students will use the engineering and design process to create an earthquake resistant structure, test their structure, and improve their structure to show how scientists and engineers try to reduce the impact of natural disasters on human populations.
- Students will discuss possible ways to reduce the impact of landslides on human populations.

Evidence of Learning

Assessment

•Students will create a map of volcanic activity around the globe. Students should be able to discuss patterns in the distribution of volcanoes and notice that volcanic activity occurs at the boundaries of tectonic plates.
•Students in two separate activities learn about different devices that are used to detect natural disasters. In one activity they learn how seismographs can help determine the intensity of an earthquake and patterns in detection can pinpoint seismic activity. In another activity the students are tasked with learning about and placing several devices around a fictitious region. Students must be able to justify their placement and how these devices will protect people in these regions
•Students are tasked with researching buildings resistant to seismic activity and creating a building of their own. Students will discuss how different materials, shapes, and weight distribution affect buildings in areas prone to seismic activity.
•Students will learn about the causes of landslides and discuss methods to protect areas prone to landslide activity.

Possible NSTA assessment for assessing prior knowledge or performing mid unit assessments:

- What do you know about earthquakes and volcanoes?

Resources

Grade/ Grade Band: 4th Grade	**Topic:** Earth Processes	**Lesson # _1_ in a series of _6_ lessons**
Brief Lesson Description: The students will begin to bridge the gap between slow changes to the Earth (via erosion, weathering, etc.) to fast changes to the Earth (via natural processes). The students will begin to explore how landslides cause rapid changes to the planet and how humans try to reduce the impact of the landslide on human communities.		
Performance Expectation(s): 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.		
Specific Learning Outcomes: Students will learn what conditions lead to landslides and brainstorm ways to protect communities prone to landslides		
Narrative / Background Information		
Prior Student Knowledge: ● Students know how erosion happens and what factors speed up or slow down the process ● Students have learned where earthquakes are likely to occur and have learned about the magnitude of earthquakes.		
Science & Engineering Practices: ● Analyzing and Interpreting Data ● Constructing Explanations and Designing Solutions ● Planning and Carrying Out Investigations	**Disciplinary Core Ideas:** ESS3.B: Natural Hazards ● A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. ETS1.B: Designing Solutions to Engineering Problems ● Testing a solution involves investigating how well it performs under a range of likely	**Crosscutting Concepts:** ● Patterns ● Cause and Effect ● Influence of Engineering, Technology, and Science on Society and the Natural World
Possible Preconceptions/Misconceptions: ● **Students think that landslides can occur anywhere and do not have factors that significantly impact the likelihood of a landslide occurring**		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4th Grade	**Topic:** Earth Processes	**Lesson # __2__ in a series of _6__ lessons**
Brief Lesson Description: Asking Questions to Determine Investigations into Natural Earth Processes/Maps		
Performance Expectation(s): 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features		
Specific Learning Outcomes: Students will generate a series of questions about earth processes (specifically volcanoes) and talk knowledgeably about Earth's elevation by performing a QFT and studying topographical maps.		
Narrative / Background Information		
Prior Student Knowledge: ● Students have background knowledge about interpreting maps to a certain degree, both in terms of city maps and climate maps. ● Students will be investigating climate change, as well as volcanic activity, in their non-fiction unit.		

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
● Asking questions (for science) and defining problems (for engineering) ● Analyzing and Interpreting Data	● ESS2.B: Plate Tectonics and Large-Scale System Interactions	● Patterns ● Stability and Change ● Scale, proportion, and quantity

Possible Preconceptions/Misconceptions:

- Students may believe that seismic and volcanic activity only occur at the edges of tectonic plates.
- Students may have a misconception about the time and scale of many maps, possibly thinking that they are standard.
- Students may have misconceptions about the type of maps they are viewing.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4th Grade	**Topic:** Earth Processes	**Lesson # __3__ in a series of _6__ lessons**

Brief Lesson Description: Volcanic Mapping using a Map grid (2 day lesson)

Performance Expectation(s):
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features

Specific Learning Outcomes: Students will be able to describe in detail patterns in Earth's features deduced from analysis of global maps of volcanic activity.

Narrative / Background Information

Prior Student Knowledge:

- Students have background knowledge about interpreting maps to a certain degree, both in terms of city maps and climate maps.
- Students will be investigating climate change, as well as seismic activity, in their non-fiction unit.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
● Engaging in an Argument from Data ● Analyzing and Interpreting Data	● ESS2.B: Plate Tectonics and Large-Scale System Interactions	● Patterns ● Stability and Change ● Scale, proportion, and quantity

Possible Preconceptions/Misconceptions:

- Students may have a misconception about the time and scale of many maps, possibly thinking that are standard.
- Students may believe that volcanic activity only occurs at the edges of tectonic plates.
- Students may have misconceptions about the type of maps they are viewing.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4th Grade	**Topic:** Earth Processes	**Lesson # __4__ in a series of _6__ lessons**

Brief Lesson Description: Exploring types of tools and measurements taken during volcanic activity

Performance Expectation(s):
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features

Specific Learning Outcomes: Students will be able to discuss how volcanoes are measured by conducting research about the tools scientists use to study volcanoes.

Narrative / Background Information		
Prior Student Knowledge: ● Students have background knowledge about the Richter Scale		
Science & Engineering Practices: ● Engaging in an Argument from Data ● Analyzing and Interpreting Data	**Disciplinary Core Ideas:** ● ESS2.B: Plate Tectonics and Large-Scale System Interactions	**Crosscutting Concepts:** ● Patterns ● Stability and Change ● Scale, proportion, and quantity
Possible Preconceptions/Misconceptions: ● Students may think the Ricther scale is linear. ● Students might confuse a seismograph with a seismometer		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4th Grade	**Topic:** Earth Processes	**Lesson # __5__ in a series of _6__ lessons**
Brief Lesson Description: Students will work in a jigsaw to learn about different disaster detection devices. Groups will use what they learned to place the detection devices around a fictional city.		
Performance Expectation(s): 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.		
Specific Learning Outcomes: Students will learn about tools that scientists use to detect disasters, how		
Narrative / Background Information		
Prior Student Knowledge: ● Students should be familiar with dangerous weather from the non-fiction reading unit. ● Students will be familiar with seismometers		
Science & Engineering Practices: ● Analyzing and Interpreting Data ● Constructing Explanations and Designing Solutions	**Disciplinary Core Ideas:** ESS3.B: Natural Hazards ● A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.	**Crosscutting Concepts:** ● Influence of Engineering, Technology, and Science on Society and the Natural World
Possible Preconceptions/Misconceptions: ● Engineers cannot prevent the natural Earth process (like an earthquake or a tsunami) from happening. They can use tools to predict these events to help keep people safe and limit the destruction of property.		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4th Grade	**Topic:** Earth Processes	**Lesson # _6_ in a series of _6_ lessons**
Brief Lesson Description: Students will build an earthquake resistant structure using given materials. Students will reflect on their designs as well as the designs of their classmates. Finally, students will make improvements to		

their initial structure.

Performance Expectation(s):
4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Specific Learning Outcomes: Students will use the engineering and design process to create an earthquake resistant structure, test their structure, and improve their structure.

Narrative / Background Information

Prior Student Knowledge:

- Students have learned where earthquakes are likely to occur and have learned about the magnitude of earthquakes.
- Students may be familiar with stable structural designs.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
● Analyzing and Interpreting Data ● Constructing Explanations and Designing Solutions ● Planning and Carrying Out Investigations	ESS3.B: Natural Hazards ● A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. ETS1.B: Designing Solutions to Engineering Problems ● Testing a solution involves investigating how well it performs under a range of likely	● Patterns ● Cause and Effect ● Influence of Engineering, Technology, and Science on Society and the Natural World

Possible Preconceptions/Misconceptions:

LESSON PLAN – 5-E Model

Teacher Professional Learning Resources

Using the NGSS Practices in the Elementary Grades

The presenters were Heidi Schweingruber from the National Research Council, Deborah Smith from Penn State University, and Jessica Jeffries from State College Area School District. In this seminar the presenters talked about applying the scientific and engineering practices described in A Framework for K–12 Science Education in elementary-level classrooms.

Continue the discussion in the community forums.

***NGSS* Core Ideas: Earth's Systems**

The presenter was Jill Wertheim from National Geographic Society. The program featured strategies for teaching about Earth science concepts that answer questions such as "What regulates weather and climate?" and "What causes earthquakes and volcanoes?"

Dr. Wertheim began the presentation by introducing a framework for thinking about content related to Earth systems. She then showed learning progressions for each concept within the Earth's Systems disciplinary core idea and shared resources and strategies for addressing student preconceptions. Dr. Wertheim also talked about

changes in the way NGSS addresses these ideas compared to previous common approaches. Participants had the opportunity to submit questions and share their feedback in the chat.

Continue the discussion in the community forums.

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 4 - Force and Motion and Engineering Design

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st-century competencies to prepare students to make informed decisions and take action to address real-world problems.
  - Cultivate an inclusive and diverse community where all learners are welcomed, valued, respected, and celebrated.

Unit: Force and Motion and Engineering Design	
Content Area: Science	
Course & Grade Level: Grade 4	
Summary and Rationale	
In this unit of study, students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object and are expected to develop an understanding that energy can be transferred from object to object through collisions. In the second half of the unit, students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from objects through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of energy and matter and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Overall, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, planning and carrying out investigations, constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate their understanding of the core ideas.	
Recommended Pacing	
10 days	
New Jersey Student Learning Standards for	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
CPI #	**Cumulative Progress Indicator (CPI)**
4-PS3-1	**Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [*Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*]
4-PS3-3	**Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]
4-PS3-4	**Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*]
3-5-ETS1-1	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**
3-5-ETS1-2	**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**
3-5-ETS1-3	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**

RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)
RI.4.3	Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why based on specific information in the text. (4-PS3-1)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably (4-PS3-1)
W.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly (4-PS3-1)
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic (4-PS3-3) (4-PS3-4)
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources (4-PS3-1) (4-PS3-3) (4-PS3-4)
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research (4-PS3-1)
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.
9.4.5.CI.4	Research the development process of a product and identify the role of failure as a part of the creative process.
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process.
New Jersey Student Learning Standards for Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.5.ED.2	Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
8.2.5.ED.3	Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
8.2.5.ED.4	Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
8.2.5.ED.5	Describe how specifications and limitations impact the engineering design process.
8.2.5.ED.6	Evaluate and test alternative solutions to a problem using the constraints and tradeoffs identified in the design process.
8.2.5.ITH.2	Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.
8.2.5.NT.1	Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
8.2.5.NT.3	Redesign an existing product for a different purpose in a collaborative team.
Interdisciplinary Standards	
4.OA.A.3	Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4)
MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-1)*(3-5-ETS1-2)(3-5-ETS1-3)
MP.4	Model with mathematics. *(3-5-ETS1-1)*(3-5-ETS1-2)(3-5-ETS1-3)
MP.5	Use appropriate tools strategically. *(3-5-ETS1-1)*(3-5-ETS1-2)(3-5-ETS1-3)

Instructional Focus

Unit Enduring Understandings

- Energy can be transferred in various ways and between objects.
- The faster a given object is moving, the more energy it possesses.
- Most scientists and engineers work in teams.
- The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.
- Possible solutions to a problem are limited by available materials and resources (constraints).
- The success of a designed solution is determined by considering the desired features of a solution (criteria).
- Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

Unit Essential Questions

- What is the relationship between the speed of an object and its energy?
- In what ways does energy change when objects collide?
- How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

Objectives

Students will know:

- Energy can be transferred in various ways and between objects.
- There is a relationship between speed and energy.

Students will be able to:

- Identify the forces involved when an object is in motion and at rest.
- Make observations and construct explanations based on collected data.
- Make observations about the effects of height and distance on energy transferred in collisions.
- Conduct various trials when conducting their experiments.
- Design a toy that converts energy from one form to another.
- Build their designed toy with teammates.
- Communicate their ideas with peers and redesign their toy based on feedback and observations.
- Construct explanations about how energy is transferred in their toy.

Evidence of Learning

Assessment

- Student collaboration
- Class discussions including observations and questions
- Student reflections and explanations of energy transfer
- Toy Maker Challenge planning, researching, constructing, evaluating, and communicating design

Resources

Core Text:

- Books
    - Energy by Anita Nahta Amin
    - How Do Objects Move? by Sullivan, Laura L.
    - Forces and Energy by Hibbert, Clare
    - Force and Motion by Anita Nahta Amin
- Mystery Science

- How is your body similar to a car?
- What makes roller coasters go so fast?

- BrainPop
  - Forces
- Videos
  - Newton's Cradle Video
  - OkayGo chain reaction
  - BBC Bitesize video (roller coaster)

Lego Stop Motion video (roller coaster)

  - Schooltube video (roller coaster)
- Other resources
  - PHET Simulation
  - Wonderopolis article

Force of Motion and Engineering Design

Grade/ Grade Band: 4	**Topic:** Force of Motion & Engineering Design	**Lesson # _1_ in a series of _4_ lessons**

Brief Lesson Description: Students will complete a formative probe - apple on a desk. Students will explore various ways to make a marble move at least six inches and consider the forces involved. This lesson serves as a review from concepts covered in third grade and an introduction into the unit.

Performance Expectation(s):
4-PS3-1 Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

Specific Learning Outcomes:
- Students begin to explore the concept of energy transfer by making a marble move a specific distance.
  - Students will identify the forces involved when an object is in motion and at rest.

Narrative / Background Information

Background Information:
Forces have both a direction and magnitude (size or strength). This makes forces a vector quantity because vector quantities have magnitude and direction. When the forces are balanced, that means that the forces acting on an object have an equal magnitude and an opposite direction. This either keeps an object at rest or in a constant motion. When the forces are unbalanced, the strength of the forces are not equal and the direction is not opposite, this will cause a change to an object's motion.

Prior Student Knowledge:
Kindergarten: Pushes and Pulls
- When objects touch or collide, they push on one another and can change motion.

Grade 3: Forces and Motion
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. When describing force, students describe both the size and direction.

Science & Engineering Practices: Constructing Explanations and Designing Solutions ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)	**Disciplinary Core Ideas:** PS3.C: Relationship Between Energy and Forces ● When objects collide, the contact forces transfer energy so as to change the objects' motions. (4- PS3-3)	**Crosscutting Concepts:** Energy and Matter ● Energy can be transferred in various ways and between objects. (4-PS3-1) (4-PS3-3)

Possible Preconceptions/Misconceptions:
Students may think that an object at rest does not have any forces acting on it. The idea that forces have a direction and magnitude (size or strength) is a challenging one. Students may initially think that a force only has a direction, or they may think that a force only has a magnitude. Additionally, students may not realize that friction is a force that acts on an object when the object moves on a surface.

LESSON PLAN – 5-E Model

Force of Motion and Engineering Design

Grade/ Grade Band: 4	**Topic:** Force of Motion & Engineering Design	**Lesson # _2_ in a series of _4_ lessons**

Brief Lesson Description: In the Mystery Science video, How is your body similar to a car? students create a model of an amusement park ride to explore the relationship between energy and speed. **This lesson may take two days.**

Performance Expectation(s):
4-PS3-2 Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
4-PS3-3 Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
4-PS3-1 Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

Specific Learning Outcomes:
- Students will explore the relationship between speed and energy.
- Students will make observations and construct explanations based on collected data.

Narrative / Background Information

Prior Student Knowledge:
Grade 3: Forces and Motion
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. When describing force, students describe both the size and direction.

Previous Lesson:
- Students should be familiar with the concepts of stored energy and the relationship between energy and speed. This lesson further expands on this concept.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Planning and Carrying Out Investigations ● Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) Asking Questions and Defining Problems ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) Constructing Explanations and Designing Solutions ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)	PS3.A: Definitions of Energy ● The faster a given object is moving, the more energy it possesses. (4-PS3-1) PS3.B: Conservation of Energy and Energy Transfer ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-3)	Energy and Matter ● Energy can be transferred in various ways and between objects. (4-PS3-1) (4-PS3-3)

Possible Preconceptions/Misconceptions:

Energy is not created or destroyed. Instead, energy is transferred in various ways and between objects. This concept may be challenging for students to grasp. It will be important to highlight the variety of ways that energy is transferred throughout this unit.

LESSON PLAN – 5-E Model

Force of Motion and Engineering Design

Grade/ Grade Band: 4	**Topic:** Force of Motion & Engineering Design	**Lesson # _3_ in a series of _4_ lessons**

Brief Lesson Description: In this Mystery Science lesson What makes roller coasters go so fast?, students continue to explore the relationship between greater energy and faster speeds. Students learn that height is another form of stored energy. Students then explore the concept of energy transfer between two colliding marbles. **This lesson may take two days.**

***This Mystery Science contains more than one experiment. The second experiment is listed in the "elaborate" section of the lesson. If there is time (an additional day), you may have students complete the second experiment, but if not, the first experiment will help students towards their understanding of the scientific concepts.**

Performance Expectation(s):
4-PS3-2 Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

4-PS3-3 Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
4-PS3-1 Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

Specific Learning Outcomes:

- Students explore the relationship between energy and speed.
- Students make observations about the effects of height and distance on energy transferred in collisions.
- Students conduct various trials when conducting their experiments.

Narrative / Background Information

Background Information:
When a moving object collides with an object at rest, energy is transferred between the objects. Not all of the energy is perfectly transferred from one object to the next, however, because energy can be transferred to the surrounding air as heat or sound.

Prior Student Knowledge:
Kindergarten: Pushes and Pulls

- When objects touch or collide, they push on one another and can change motion.

Grade 3: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. When describing force, students describe both the size and direction.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Planning and Carrying Out Investigations ● Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) Asking Questions and Defining Problems ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) Constructing Explanations and Designing Solutions ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation.	PS3.A: Definitions of Energy ● The faster a given object is moving, the more energy it possesses. (4-PS3-1) ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-3) PS3.B: Conservation of Energy and Energy Transfer ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated	Energy and Matter ● Energy can be transferred in various ways and between objects. (4-PS3-1) (4-PS3-3)

(4-PS3-1)	and sound is produced. (4-PS3-3) PS3.C: Relationship Between Energy and Forces ● When objects collide, the contact forces transfer energy so as to change the objects' motions. (4- PS3-3) PS3.D: Energy in Chemical Processes and Everyday Life ● The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)	

Possible Preconceptions/Misconceptions:
Students may have trouble understanding that adding height leads to a greater amount of stored energy. To help students better understand this, you can relate height to an increase in turns of the rubber band in the previous experiments. Students may also think that when objects collide all of the energy is transferred from the first object to the second. Students may not realize that the sound produced is some of the first object's energy being transferred to the surrounding air.

LESSON PLAN – 5-E Model

Force of Motion and Engineering Design

Grade/ Grade Band: 4	**Topic:** Force of Motion & Engineering Design	**Lesson #** _4_ **in a series of** _4_ **lessons**

Brief Lesson Description: During this lesson, students will use the engineering design loop and all they know about forces, motion, and energy transfer to work within a collaborative group to create a toy that converts one form of energy to another. At the end of the lesson, students will be creating either a recorded commercial or poster presentation to convince their peers to buy their toy. It will be important that teams are able to explain the energy transfer that occurs in their toy. **This lesson will take at least 5 days.**

This lesson was inspired by:
http://teachers.egfi-k12.org/build-a-toy-workshop/?utm_source=Teachers+Newsletter+December+2013&utm_campaign=egfi+teachers+sept.+2013&utm_medium=archive

Performance Expectation(s):
4-PS3-4 Apply scientific ideas to solve design problems.
3-5-ETS1-2 Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
3-5-ETS1-1 Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
3-5-ETS1-3 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Specific Learning Outcomes:

- Students will design a toy that converts energy from one form to another.
- Students will build their designed toy within teams.
- Students will communicate their ideas with peers and redesign their toy based on feedback and observations.
- Students will construct explanations about how energy is transferred in their toy.

Narrative / Background Information

Prior Student Knowledge:

Kindergarten: Pushes and Pulls

- When objects touch or collide, they push on one another and can change motion.
- Pushes and pulls can have different strengths and directions.
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.
- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

Grade 3: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. When describing force, students describe both the size and direction.

Science & Engineering Practices:

Constructing Explanations and Designing Solutions

- Apply scientific ideas to solve design problems. (4-PS3-4)
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Asking Questions and Defining Problems

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Planning and Carrying Out Investigations

- Plan and conduct an

Disciplinary Core Ideas:

PS3.B: Conservation of Energy and Energy Transfer

- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4)

PS3.C: Relationship Between Energy and Forces

- When objects collide, the contact forces transfer energy so as to change the objects' motions. (4- PS3-3)

PS3.D: Energy in Chemical Processes and Everyday Life

- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

Crosscutting Concepts:

Energy and Matter

- Energy can be transferred in various ways and between objects. (4-PS3-1) (4-PS3-3)

Connections to Engineering, Technology, and Applications of Science

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

- Engineers improve existing technologies or develop new ones. (4-PS3-4)

Connections to Nature of Science

Science is a Human Endeavor

- Most scientists and engineers work in teams. (4- PS3-4)
- Science affects everyday life. (4-PS3-4)

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

investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)	ETS1.A: Defining and Delimiting Engineering Problems ● Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3- 5-ETS1-1) ETS1.B: Developing Possible Solutions ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5- ETS1-2) ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5- ETS1-3) ETS1.C: Optimizing the Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)	● People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1) ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Possible Preconceptions/Misconceptions:

As students are designing their toys, they will need to be reminded of the constraints they have - time and materials. Students who create elaborate designs may not have enough time to build their design. Additionally, the focus of this lesson is energy transfer. It is possible that students may need help keeping the energy transfer the focus as they design and build their toy. Checking in frequently with teams throughout this lesson will be important.

LESSON PLAN – 5-E Model

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 4 - Structures and Functions

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.

Unit 3: Structures and Functions	
Content Area: Science	
Course & Grade Level: 4	
Summary and Rationale	
In this unit of study, students develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. The crosscutting concepts of *systems and system models* are called out as organizing concepts for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency *in engaging in argument from evidence*. Students are also expected to use this practice to demonstrate understanding of the core idea.	
Recommended Pacing	
10-12 days	
New Jersey Student Learning Standards	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
CPI #	**Cumulative Progress Indicator (CPI)**
4-LS1-1	**Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** *[Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.]* [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.*]*
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**
W.4.1	Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a)
9.4.5.CI.4	Research the development process of a product and identify the role of failure as a part of the creative process
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2)
CPI #	**Cumulative Progress Indicator (CPI)**
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.2.A.4	Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games, museums).
8.1.5.A.3	Use a graphic organizer to organize information about a problem or issue.
Interdisciplinary Standards	
Standard: NJ Student Learning Standards for Mathematics	

CPI #	Cumulative Progress Indicator (CPI)
4.G.A.3	Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)

Instructional Focus

Unit Enduring Understandings

- A system can be described in terms of its components and their interactions.
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Unit Essential Questions

- How do the internal and external parts of plants and animals support their survival, growth, behavior, and reproduction?

Objectives

Students will know:

- that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- that animals do not choose the adaptations they develop, and that evolution is not a choice.
- the difference between camouflage and mimicry.
- the common structures of plants and the functions of these plant structures.

Students will be able to:

- identify traits (internal or external) of living things based upon pictures and/or prior knowledge and describe how these traits help them to survive.
- define vocabulary that is necessary to understand the ideas of adaptations, structure, function, and internal/external traits.
- identify the function of mouths based upon its structures
- classify animals as using camouflage or mimicry
- research specific biomes and identify plant adaptations
- design a bird beak by following a design brief

Evidence of Learning

Assessment

- Class discussions and reflections on various topics and activities throughout the unit
- Students will research a specific biome and design a plant that has specific adaptations that will survive in that environment
- Students will participate in a project based learning assessment on designing and creating bird beaks for specific functions.

Resources

Grade/ Grade Band: 4th Grade	**Topic:** Introduction to Structures and Functions	**Lesson # 1 in a series of 11 lessons**
Brief Lesson Description: Students will briefly explore the ideas of adaptation, structure, function, internal and external traits.		
Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		
Specific Learning Outcomes: Students will be able to identify traits (internal or external) of living things based upon pictures and/or prior knowledge and describe how these traits help them to survive.		
Narrative / Background Information		
Prior Student Knowledge: **Grade 1 Unit 3: Mimicking Organisms to Solve Problems** ● All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. ● Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.		
Science & Engineering Practices: Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	**Disciplinary Core Ideas:** Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	**Crosscutting Concepts:** Substructures have shapes and parts that serve functions.
Possible Preconceptions/Misconceptions: Students may misunderstand how evolution and adaptations happen. Students may believe that animals purposely evolve to survive. Students may have difficulty identifying: What are adaptations? What is a system? How do adaptations help animals survive?		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4th Grade	**Topic:** Animal external traits and their functions	**Lesson # 2 in a series of 11 lessons**
Brief Lesson Description: Students will participate in an activity that demonstrates how certain tools are better than others for a specific job. Students will learn more vocabulary related to the ideas of adaptation, structure, function, internal and external traits.		
Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		
Specific Learning Outcomes: Students will be able to define vocabulary that is necessary to understand the ideas of adaptations, structure, function, and internal/external traits.		

Students will be able to identify the function of a mammal mouth based upon its structure.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	Substructures have shapes and parts that serve functions.

Possible Preconceptions/Misconceptions:

Students may confuse how adaptations work. The animal did not make their mouth or feature to eat a certain food source, but rather their ancestors slowly evolved to have a particular mouth part or feature because they were able to eat the most available resource. These ancestors were then able to survive and reproduce, creating more animals with this mouth/feature.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4th Grade	**Topic:** Animal external traits and their functions	**Lesson # 3 in a series of 11 lessons**

Brief Lesson Description: Students will explore how differences in animal external features (specifically, insects' mouths) can help discover the function of a particular part. Students will try to "eat" a variety of food using different insect mouths to determine how the shape of an insect mouth is related to both its environment and food sources.

Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Specific Learning Outcomes: Students will understand how insect mouthparts are adapted for a particular food source.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp

objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.

- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Prior Lessons:

Students have a basic understanding of adaptations and should understand that adaptations aren't made or used but are a result of generations of surviving ancestors.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model.	Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	**A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)**

Possible Preconceptions/Misconceptions:

Students may confuse how adaptations work. The animal did not make their mouth or feature to eat a certain food source, but rather their ancestors slowly evolved to have a particular mouth part or feature because they were able to eat the most available resource. These ancestors were then able to survive and reproduce, creating more animals with this mouth/feature.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Animal external traits and their functions	**Lesson # 4 in a series of 11 lessons**

Brief Lesson Description: Using images students will discuss the differences between camouflage and mimicry. Students will discuss how each animal has one of the aforementioned adaptations and how this contributes to their survival.

Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Specific Learning Outcomes:
Students will be able to identify the differences between camouflage and mimicry.
Students will be able to classify animals as using camouflage or mimicry.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external

inputs.

Prior Lessons:

Students have a basic understanding of adaptations and should understand that adaptations aren't made or requested but are a result of generations of surviving ancestors.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model.	Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)

Possible Preconceptions/Misconceptions:

Students may confuse disguise camouflage and mimicry (disguise camouflage can look like something innocuous in the environment, whereas mimicry looks like another organism (often dangerous [prey] or attractive [predator]).

Students may not immediately recognize the camouflage as coloring in fur or exoskeletal structure.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** External Plant Structures	**Lesson # 5-6 in a series of 11 lessons**

Brief Lesson Description: Students begin the lesson by comparing three plants and thinking about what plants need to survive. After reviewing six biomes, students will match plant structures with their corresponding environments. Students then read about structures and adaptations that plants have in order to survive in specific environments. Students will use this information to create their own plant. When creating this plant, students need to be able to describe the specific structures and the purpose (function) of those structures.

****At the end of the lesson, set up the celery experiment for the internal structures lesson.**

Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Specific Learning Outcomes:

Students will identify the common structures of plants.
Students will describe the function of specific plant structures.
Students will research the structures and functions of plants in specific biomes.
Students will create a plant with structures that would help the plant survive in a specific environment.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp

objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.

- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	Substructures have shapes and parts that serve functions.

Possible Preconceptions/Misconceptions:

- Adaptations are not a choice - plants do not choose to have thicker leaves, petals, etc.
- While only four main structures of plants are specifically taught, plants have many structures that help them survive in their environment. These structures usually have more than one purpose.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Internal Plant Structures	**Lesson # 7 in a series of 11 lessons**

Brief Lesson Description:

***Ideally, the celery part of the experiment should be set up 1 to 3 days in advance. This lesson has many options for vegetable dissection. Choose the one that makes the most sense for the time you have and for your class.

Students will dissect a vegetable and make observations about the internal structures that support growth and survival of the plant.

Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Specific Learning Outcomes:

Students will identify and locate the structure that allows water to travel throughout plants through dissecting a common vegetable.
Students will construct an argument that plants have internal structures that support the survival and growth of the plant.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	Substructures have shapes and parts that serve functions.

Possible Preconceptions/Misconceptions:

Plants are living, and just like animals, they have internal structures that help them survive, grow, and reproduce. When dissecting, remind students that there is no eating in science lab.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4th Grade	**Topic:** Structure and Function Project	**Lesson # 8 in a series of 11 lessons**

Brief Lesson Description: Mystery Science lesson titled, how does your brain control your body?

Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Specific Learning Outcomes:

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed	Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)

by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model.		

Possible Preconceptions/Misconceptions:

Students will want examples of how to create the bird beaks, do not give them any ideas, let them explore with the materials on their own. You are the facilitator in this activity, guide students through the design process.

Some students might be quick to create a 'scooping' beak for any food type, however remind students of the different birds and where their food would be located. A finch may not always have a bowl of seeds to pick through, how else could they find their food, what does their beak need to have in order to reach this food.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4th Grade	**Topic:** Structure and Function Project	**Lesson # 9-11 in a series of 11 lessons**

Brief Lesson Description: Project based learning assessment on designing and creating bird beaks for specific functions. This lesson will consist of three class periods.

Performance Expectation(s): Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Specific Learning Outcomes:

Students will be able to identify the variations that can be observed in different types of bird beaks.
Students will be able to create a self-designed bird beak that can eat 'pick up' their designated food sample.
Students will be able to reflect on their designed bird beaks and outcomes to identify what/how they would redesign it in the future.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 3: Mimicking Organisms to Solve Problems

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed	Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)

by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model.		

Possible Preconceptions/Misconceptions:

Students will want examples of how to create the bird beaks, do not give them any ideas, let them explore with the materials on their own. You are the facilitator in this activity, guide students through the design process.

Some students might be quick to create a 'scooping' beak for any food type, however remind students of the different birds and where their food would be located. A finch may not always have a bowl of seeds to pick through, how else could they find their food, what does their beak need to have in order to reach this food.

LESSON PLAN – 5-E Model

Teacher Professional Learning Resources

Connections Between Practices in *NGSS*, Common Core Math, and Common Core ELA

The presenter was Sarah Michaels from Clark University. In this seminar Dr. Michaels talked about connecting the scientific and engineering practices described in A Framework for K–12 Science Education with the Common Core State Standards in Mathematics and English Language Arts.

Engineering Design as a Core Idea

The presenter was Cary Sneider, Associate Research Professor at Portland State University in Portland, Oregon. The seminar focused on the Core Idea of Engineering, led by Cary Sneider, Associate Research Professor at Portland State University. Cary explained the overall *NGSS* engineering components for K-2, MS and HS, and went through a number of practical examples of how teachers could develop modules and investigations for their students to learn them. Cary also spoke about the ways in which teachers could include cross-cutting engineering concepts to a number of classroom subjects. The seminar concluded with an overview of NSTA resources about *NGSS* available to teachers by Ted, and a Q & A session with Cary.

Visit the resource collection.

Continue discussing this topic in the community forums.

NGSS Core Ideas: From Molecules to Organisms: Structures and Processes

The presenters were Aaron Rogat of Educational Testing Service (ETS) and Barbara Hug of the University of Illinois at Urbana-Champaign. The program featured strategies for teaching about life science concepts that answer questions such as "How do the structures of organisms enable life's functions?" and "How do organisms grow and develop?"

Dr. Hug began the presentation by discussing the arrangement of life science core ideas within *NGSS* and comparing them to previous standards. Next, Dr. Rogat shared an example of a learning progression, showing how a concept can be taught from early elementary through high school. The presenters then talked about strategies for instruction and shared links to resources. Participants had the opportunity to submit their questions and comments in the chat.

Visit the resource collection.

Continue discussing this topic in the community forums.

Annenberg Media's Teachers' Resources are short video courses covering essential science content for K-6 teachers.

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 4 - Transfer of Energy

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.
  - Cultivate an inclusive and diverse community where all learners are welcomed, valued, respected, and celebrated.

Unit: Transfer of Energy	
Content Area: Science	
Course & Grade Level: Grade 4	
Summary and Rationale	
In this unit of study, fourth-grade students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents. Students also obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. The crosscutting concepts of cause and effect, energy and matter, and the interdependence of science, engineering, and technology, and influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations and obtaining, evaluating, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas.	
Recommended Pacing	
7 days	
New Jersey Student Learning Standards for	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
CPI #	**Cumulative Progress Indicator (CPI)**
4-PS3-2	**Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** *[*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]*
4-ESS3-1	**Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** *[Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]*
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.

SL.4.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.
W.4.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process
9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.P.C.1	Collaborate with peers by participating in interactive digital games or activities.
8.1.5.F.1	Apply digital tools to collect, organize, and analyze data that support a scientific finding
8.2.5.A.2	Investigate and present factors that influence the development and function of a product and a system.
8.2.5.A.3	Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints.
8.2.5.C.4	Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.
8.2.5.D.2	Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process to evaluate potential solutions.
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.
Interdisciplinary Standards	
MP.2	Reason abstractly and quantitatively.
MP.5	Use appropriate tools strategically.
4.MD.A.1	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.
4.MD.A.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
4.MD.B	Represent and interpret data.
NJSLS-S K-12 Climate Change Standards	
3-ESS3-1	Make a claim about the merit of a design solution that reduces the impacts of climate change and/or a weather-related hazard. [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning]

5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.

Instructional Focus

Unit Enduring Understandings

- Energy can be transferred in various ways and between objects.
- Energy can be moved from place to place through sound, light, or electric currents.
- Energy is present whenever there is sound, light, or heat.
- Light also transfers energy from place to place.
- Energy can also be transferred from place to place by electric currents; the currents may have been produced to begin with by transforming the energy of motion into electrical energy.
- Energy and fuels that humans use are derived from natural sources.
- The use of energy and fuels from natural sources affects the environment in multiple ways.
- Some resources are renewable over time, and others are not.

Unit Essential Questions

- How can energy move between objects?
- How can energy change form when it is transferred between objects?
- How do humans derive their energy?
- What are the differences between renewable and nonrenewable resources?

Objectives

Students will know:

- There are many different forms of energy that exist in the universe including moving energy and stored energy
- Energy can be transferred between objects in many different ways
- Energy can change forms, this change often produces heat
- Electricity and heat are two different forms of energy
- The source of human energy comes in many forms including renewable and nonrenewable energy.
- Nonrenewable energy often involve combustion and can cause pollution and hazards to human health
- Renewable energy has its constraints in terms of where and when it can work.
- Choosing an energy source requires many different community members including: scientists, politicians, city planners, etc.

Students will be able to:

- Identify, test, and use cause-and-effect relationships in order to explain change.
- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
    - Examples of renewable energy resources could include:
        - Wind energy,
        - Water behind dams, and
        - Sunlight.
    - Examples of nonrenewable energy resources are:
        - Fossil fuels,
        - Fissile materials
    - Examples of environmental effects could include:
        - Loss of habitat due to dams

- Loss of habitat due to surface mining
- Air pollution from burning of fossil fuels.

- Support explanations using patterns as evidence.
- Identify the evidence that supports particular points in an explanation.

Evidence of Learning

Assessment

- Assessment Probe
- Student creations and discussions regarding flashlights, heat spinners and renewable energy models
- Class discussions including student observations and questions
- Student created models, evaluation of models including potential strengths and weaknesses, and consideration for the limitations of models
- Student constructed explanation using patterns as evidence

Resources

Core Text:

Mystery Science

- Electricity
- Heat
- Renewable Energy

BrainPop

- Energy

Grade/ Grade Band: 4	**Topic:** Transfer of Energy	**Lesson # ___1__ in a series of __5___ lessons**
Brief Lesson Description: Students will display prior knowledge about the concept of energy and learn the distinction between energy and matter		
Performance Expectation(s): Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.		
Specific Learning Outcomes: Students will be able to make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents by accessing prior knowledge about the concept of energy.		
Narrative / Background Information		
Prior Student Knowledge: ● **Students may have some knowledge about certain forms of energy (nuclear, electrical)** ● **Students have learned about alternative forms of energy**		
Science & Engineering Practices: **Use prior knowledge to describe problems that can be solved.**	**Disciplinary Core Ideas:** **Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred**	**Crosscutting Concepts:** **Energy can be transferred in various ways and between objects.** **Cause and effect relationships are routinely identified, tested, and used to explain change.**

	to the surrounding air; as a result, the air gets heated and sound is produced **Energy can be moved from place to place by moving objects or through sound, light, or electric currents.**	
Possible Preconceptions/Misconceptions: ● **Students may confuse the source of energy and the type of energy (wind vs mechanical)** ● **Students may think that not all matter contains energy** ● **Students may believe that all energy causes visible motion**		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4	**Topic:** Transfer of Energy (Electricity)	**Lesson # ___2__ in a series of ___5__ lessons**
Brief Lesson Description: Students will explore electrical energy by building a flashlight *This lesson will likely take 2 days		
Performance Expectation(s): Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.		
Specific Learning Outcomes: Students will be able to make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents by exploring how electrical energy can be transferred through conductive circuits.		
Narrative / Background Information		
Prior Student Knowledge: ● Students may have some knowledge about certain forms of energy (nuclear, electrical) ● Students have learned about alternative forms of energy ● Students know that light is a form of energy that travels in waves		
Science & Engineering Practices: **Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.** **Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.**	**Disciplinary Core Ideas:** **Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.** **Energy can be moved from place to place by moving objects or through sound, light, or electric currents.**	**Crosscutting Concepts:** **Energy can be transferred in various ways and between objects.** **Cause and effect relationships are routinely identified, tested, and used to explain change.**
Possible Preconceptions/Misconceptions: ● Electricity can only travel through wires ● There is some type of matter called electricity that moves through wires ● Touching any two points on a battery can transfer electricity		

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Transfer of Energy	**Lesson # __3_ in a series of _5__lessons**
Brief Lesson Description: Students will explore the basics of heat engines *This lesson will take 2 days		
Performance Expectation(s): Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.		
Specific Learning Outcomes: Students will be able to make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents by exploring how rising hot air can transfer energy into a pinwheel.		
Narrative / Background Information		
Prior Student Knowledge: ● Students may have some knowledge about certain forms of energy (nuclear, electrical) ● Students have learned about alternative forms of energy ● Students know that light is a form of energy that travels in waves		
Science & Engineering Practices: **Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.** **Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.**	**Disciplinary Core Ideas:** **Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced** **Energy can be moved from place to place by moving objects or through sound, light, or electric currents.**	**Crosscutting Concepts:** **Energy can be transferred in various ways and between objects.** **Cause and effect relationships are routinely identified, tested, and used to explain change.**
Possible Preconceptions/Misconceptions: ● Heat is a particle or piece of matter ● Heat is moving the propeller ● Heat has to be very hot (Temperature dependent) ○ Heat is just transferring thermal energy into a system		
LESSON PLAN – 5-E Model		
Elaborate Further / Reflect: Enrichment: **Mystery Science Elaborate section**		

Grade/ Grade Band: 4	**Topic:** Alternative energy sources	**Lesson # _4_ in a series of _5__ lessons**
Brief Lesson Description: Students will explore different alternative energy sources by deciding on an energy source for a model town. *This lesson will likely take 2 days		

Performance Expectation(s): Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.		
Specific Learning Outcomes: Students will be able to obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment by exploring alternative energy sources in a digital model.		
Narrative / Background Information		
Prior Student Knowledge: ● Students have most likely heard of some of the energy issues facing the world. ● They may be familiar with some energy source (Both renewable and nonrenewable) ● Students have knowledge of some engines that use heat to power them (heat can be from renewable or nonrenewable sources)		
Science & Engineering Practices: **Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.** **Use prior knowledge to describe problems that can be solved.**	**Disciplinary Core Ideas:** **• Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.**	**Crosscutting Concepts:** **Energy can be transferred in various ways and between objects.** **Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.**
Possible Preconceptions/Misconceptions: ● All alternative energy sources can be used at all times ● All alternative energy sources can be used in any location ● Alternative energy sources include only solar and wind energy		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4	**Topic:** Alternative energy sources	**Lesson # _5_ in a series of _5__ lessons**
Brief Lesson Description: Students will explore the impact of alternative energies on communities		
Performance Expectation(s): Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.		
Specific Learning Outcomes: Students will be able to obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment by exploring how alternative energies impact communities		
Narrative / Background Information		
Prior Student Knowledge: ● Students will have heard of some of the energy issues facing the world. ● Students have recently studied renewable energy ● Students have knowledge of some engines that use heat to power them (heat can be from renewable or nonrenewable sources)		

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. **Use prior knowledge to describe problems that can be solved.**	**• Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.**	**Energy can be transferred in various ways and between objects.** **Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.**

Possible Preconceptions/Misconceptions:

- All alternative energy sources can be used at all times
- All alternative energy sources can be used in any location
- Alternative energy sources include only solar and wind energy
- Alternative energies only impact the global community, not individual ones

LESSON PLAN – 5-E Model

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 4 - Waves and Information

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.
  - Cultivate an inclusive and diverse community where all learners are welcomed, valued, respected, and celebrated.

Unit: Waves and Information	
Content Area: Science	
Course & Grade Level: Grade 4	
Summary and Rationale	
In this unit of study, students use a model of waves to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move. The crosscutting concepts of *patterns; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in developing and *using models*, *planning and carrying out investigations*, and *constructing explanations*, *and designing solutions*. Students are also expected to use these practices to demonstrate their understanding of the core ideas.	
Recommended Pacing	
8 days	
New Jersey Student Learning Standards for	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
CPI #	**Cumulative Progress Indicator (CPI)**
4-PS4-1	**Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** *[Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]*
4-PS4-3	**Generate and compare multiple solutions that use patterns to transfer information.** *[Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]*
3-5-ETS1-3	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
3-5-ETS1-3	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
W.4.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.

W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process
9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.P.C.1	Collaborate with peers by participating in interactive digital games or activities.
8.1.5.F.1	Apply digital tools to collect, organize, and analyze data that support a scientific finding
8.2.5.A.2	Investigate and present factors that influence the development and function of a product and a system.
8.2.5.A.3	Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints.
8.2.5.C.4	Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.
8.2.5.D.2	Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process to evaluate potential solutions.
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
9.4.5.DC.6	Compare and contrast how digital tools have changed social interactions
9.4.5.TL.1	Compare the common uses of at least two different digital tools and identify the advantages and disadvantages of using each.
New Jersey Student Learning Standards for Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
	Information needs a physical or wireless path to travel to be sent and received.
Interdisciplinary Standards (fill-in Science, or SS, or Math, etc..)	
MP.2	Reason abstractly and quantitatively.
MP.5	Use appropriate tools strategically.
4.MD.A.1	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.
4.MD.A.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
Instructional Focus	
Unit Enduring Understandings	
● Science findings are based on recognizing patterns. ● Similarities and differences in patterns can be used to sort and classify natural phenomena. ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface.	

- When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks)
- Similarities and differences in patterns can be used to sort and classify designed products.
- Knowledge of relevant scientific concepts and research findings is important in engineering.
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—that is, convert it from digitized form to voice and vice versa.
- Different solutions need to be tested in order to determine which of them best solve the problem, given the criteria and the constraints.

Unit Essential Questions

- If a beach ball lands in the surf, beyond the breakers, what will happen to it?*
- Which team can design a way to use patterns to communicate with someone across the room?

Objectives

Students will know:

- Waves are repeated patterns of motion through a medium
- Mediums can vary widely from water to particles of air
- Waves can be measured by looking at their wavelength and amplitude (not quantitative)
- Waves cause objects to move in different ways
- Information from waves can be digitized and sent over long distances
    - Information has been sent in this way throughout history (drum messages, smoke signals, morse code, binary, etc.)
    - This information does not diminish in the way that sound ways do
- Sound waves are vibrations that travel through the air.
    - These waves can be amplified or interfered with.

Students will be able to:

- Sort and classify natural phenomena using similarities and differences in patterns.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
- Develop a model (e.g., diagram, analogy, or physical model) of waves to describe patterns in terms of amplitude and wavelength, and that waves can cause objects to move. (Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength).
- Sort and classify designed products using similarities and differences in patterns.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Generate and compare multiple solutions that use patterns to transfer information. Examples of solutions could include:
- Drums sending coded information through sound waves;
- Using a grid of ones and zeroes representing black and white to send information about a picture;
- Using Morse code to send text.

- Plan and conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Evidence of Learning

Assessment

- Student collaboration
- Student drawings of waves with appropriate labels
- Student discussion of telephone improvements
- Student binary and "cell phone" models

Resources

Core Text:

Mystery Science

- https://mysteryscience.com/waves/mystery-1/sound-vibration-engineering/50
- https://mysteryscience.com/waves/mystery-2/sound-vibrations/51

BrainPop

- Waves

Waves and Information Unit Plans

Grade/ Grade Band: 4	**Topic:** Waves and Information	**Lesson #** __1__ **in a series of** __6__ **lessons**

Brief Lesson Description: Students will be introduced to the concepts of waves through hands-on investigations and class discussions.

Performance Expectation(s):

Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. 4-PS4-1

Generate and compare multiple solutions that use patterns to transfer information. 4-PS4-3

Specific Learning Outcomes: Students will explore the concepts of waves through hands-on investigations and experiments.

Narrative / Background Information

Prior Student Knowledge:

By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances.

By the end of Grade 2, students know that: • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and

a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) ***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence ● Science findings are based on recognizing patterns. (4-PS4-1)	**PS4.A: Wave Properties** ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) ● Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** ● Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

	determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	

Possible Preconceptions/Misconceptions:

Waves are a disturbance that travels through a medium. This includes air. Students may have trouble conceptualizing air as a medium. There is a video in the Elaborate Further section of lesson 3 that illustrates this point.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Waves and Information	**Lesson #** __2__ **in a series of** __6_ **lessons**

Brief Lesson Description: Students will participate in a Teach Engineering lesson which includes a hands-on activity to help students become more familiar with a wave's wavelength and amplitude.

Performance Expectation(s): Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Specific Learning Outcomes:
Students will be able to identify a wave's wavelength and amplitude.
Students will be able to create waves of varying amplitudes and wavelengths.

Narrative / Background Information

Prior Student Knowledge:

By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances.

By the end of Grade 2, students know that: • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) ***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence ● Science findings are based on recognizing patterns. (4-PS4-1)	**PS4.A: Wave Properties** ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) ● Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** ● Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

Possible Preconceptions/Misconceptions:

Vocabulary is important in this lesson. Students may initially confuse amplitude and wavelength. Additionally, amplitude is measured from the crest (*top or bottom of the wave*) to the equilibrium point (essentially the x axis on a wave diagram).

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Waves and Information	**Lesson #** __3__ **in a series of** __6__ **lessons**

Brief Lesson Description: Students will participate in model creation to describe how ocean waves move objects

Performance Expectation(s): Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Specific Learning Outcomes:
Students will be able to identify a wave's wavelength and amplitude.
Students will be able to discuss how ocean waves move objects

Narrative / Background Information

Prior Student Knowledge:

By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances.

By the end of Grade 2, students know that: • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design	**PS4.A: Wave Properties** ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural

solutions. ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) ***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence ● Science findings are based on recognizing patterns. (4-PS4-1)	deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	phenomena. (4-PS4-1) ● Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** ● Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)
Possible Preconceptions/Misconceptions: Vocabulary is important in this lesson. Students may initially confuse amplitude and wavelength. Additionally, amplitude is measured from the crest (*top or bottom of the wave*) to the equilibrium point (essentially the x axis on a wave diagram). Students may also believe that all waves push objects in a forward motion.		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4	**Topic:** Waves and Information	**Lesson #** __4__ **in a series of** 6 **lessons**
Brief Lesson Description: In this Mystery Science video, students create a paper cup telephone to learn about sound vibrations and how they are transported through sound waves. **This lesson will take two days.**		
Performance Expectation(s): Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.		
Specific Learning Outcomes: Students will be able to create a device that is able to transmit information over a distance.		

Narrative / Background Information

Prior Student Knowledge:

By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances.

By the end of Grade 2, students know that: • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and	**PS4.A: Wave Properties** ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) ● Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) ***Connections to Engineering, Technology, and Applications of Science***

designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) ***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence ● Science findings are based on recognizing patterns. (4-PS4-1)	differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	**Interdependence of Science, Engineering, and Technology** ● Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

Possible Preconceptions/Misconceptions:

In this experiment, some students may think that the sound waves are traveling through the string. Students may also think that, in general, sound waves travel through telephone wires or through mobile data "waves" to transmit information.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Waves and Information	**Lesson #** __5__ **in a series of** _6__ **lessons**

Brief Lesson Description: This lesson will help to extend the learning from the previous string and paper cup telephone experiment. Students will explore how information can be communicated over a long distance as they work to communicate a single 4 to 5 letter word across the room.

Performance Expectation(s): Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. Describe how sound waves can be digitized and transmitted over long distances.

Specific Learning Outcomes:

Students will explore how information can be transmitted over a distance.
Students will work with their team to communicate a single word across the room.

Narrative / Background Information

Prior Student Knowledge:

By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances.

By the end of Grade 2, students know that: • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Science & Engineering Practices:

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in

Disciplinary Core Ideas:

PS4.A: Wave Properties

- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

Crosscutting Concepts:

Patterns

- Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1)
- Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering.

designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) ***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence ● Science findings are based on recognizing patterns. (4-PS4-1)	**PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	(4-PS4-3)
Possible Preconceptions/Misconceptions: ● Some students may be familiar with different ways that information can be transmitted long distance ● Some students may know about binary, but not how binary and circuits are connected (not assessed at this time) ● Some students may believe that sound waves/vibrations travel through telephone wires or through mobile data "waves" to transmit information.		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4	**Topic:** Waves and Information	**Lesson #** __6__ **in a series of** _6_ **lessons**
Brief Lesson Description: Students will learn about echolocation through participating in an activity to help better understand echolocation and how it works.		
Performance Expectation(s): Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.		
Specific Learning Outcomes: Students will be able to define echolocation and identify the types of animals that use it.		
Narrative / Background Information		
Prior Student Knowledge: By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances. By the end of Grade 2, students know that: • A situation that people want to change or create can be		

approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3) ***Connections to Nature of Science***	**PS4.A: Wave Properties** ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) ● Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** ● Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

Scientific Knowledge is Based on Empirical Evidence ● Science findings are based on recognizing patterns. (4-PS4-1)	information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	
Possible Preconceptions/Misconceptions: ● Only bats can use echolocation ● Echolocation is an additional sense that requires a special organ ● Echolocation is similar to seeing		
LESSON PLAN – 5-E Model		

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 4 - Weathering and Erosion

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.

Unit 1: Weathering and Erosion	
Content Area: Science	
Course & Grade Level: Grade 4	
Summary and Rationale	
In this unit of study, students develop understandings of the effects of weathering and the rate of erosion by water, ice, wind, and vegetation. The cross-cutting concepts of patterns and cause and effect are organizing concepts within this unit. Students demonstrate grade-appropriate efficiency in planning and carrying out investigations and constructing explanations as they use models to observe the effects of earth processes in the natural environment and consider changes that occur over time to earth materials. Students are expected to use these practices to demonstrate their understanding of the core ideas.	
Recommended Pacing	
12 days	
New Jersey Student Learning Standards for	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
CPI #	**Cumulative Progress Indicator (CPI)**
4-ESS2-1	**Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** *[Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.]* [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*]*
4-ESS1-1	**Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [*Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.*]
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process

9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.P.C.1	Collaborate with peers by participating in interactive digital games or activities.
8.1.5.F.1	Apply digital tools to collect, organize, and analyze data that support a scientific finding
8.2.5.A.1	Compare and contrast how products made in nature differ from products that are human made in how they are produced and used.
8.2.5.A.2	Investigate and present factors that influence the development and function of a product and a system.
8.2.5.A.3	Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints.
8.2.5.C.4	Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.
8.2.5.D.2	Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process to evaluate potential solutions.
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.P.C.1	Collaborate with peers by participating in interactive digital games or activities.
Interdisciplinary Standards	
MP.2	Reason abstractly and quantitatively.
MP.5	Use appropriate tools strategically.
4.MD.A.1	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.
4.MD.A.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Instructional Focus

Unit Enduring Understandings

- Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
- Weathering is the process of breaking down sediments. Erosion is the movement of sediments. Deposition occurs when sediments are dropped to new places.
- Specific structures can be built to reduce the impact of erosion.
- The presence and location of certain fossil types indicate the order in which rock layers were formed.

Unit Essential Questions

- How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?
- What can rock formations tell us about the past?

Objectives

Students will know:

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.

- Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
- Rainfall helps to shape the land and affects the types of living things found in a region.
- Living things affect the physical characteristics of their regions.
- Science assumes consistent patterns in natural systems.
- Patterns can be used as evidence to support an explanation.
- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.
- The presence and location of certain fossil types indicate the order in which rock layers were formed.

Students will be able to:

- Identify, test, and use cause-and-effect relationships in order to explain change.
- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- Make observations to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- Support explanations using patterns as evidence.
- Identify the evidence that supports particular points in an explanation.
- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Evidence of Learning

Assessment

- Student collaboration
- Class discussions including student observations and questions
- Student created models, evaluation of models including potential strengths and weaknesses, and consideration for the limitations of models
- STEM challenge designing a structure to reduce the impact of coastal erosion
- Constructed explanation using patterns as evidence

Resources

Core Text:

Mystery Science

- Will A Mountain Last Forever?
- How Old is the Earth?

BrainPop

- Erosion BrainPop

PBS

- Living Shoreline

Wonder of Science

- How Was the Grand Canyon Formed?

Grade/ Grade Band: 4	**Topic:** Weathering Introduction	**Lesson # _1_ in a series of _5_ lessons**
Brief Lesson Description: In this lesson, students explore how solid rock breaks into smaller pieces in a process called weathering. At the start of the lesson, students will watch a Mystery Science video that shows how rocks can be broken down into smaller pieces. Students will then work in teams to model the weathering process using sugar cubes.		
Performance Expectation(s): Students work with their partners in their models to explore the process of weathering. Ask students to think about the limitations of the model they have been working on for this exploration.		
Specific Learning Outcomes: Students will work collaboratively to determine the effects of weathering by modeling a a weathering scenario using sugar cubes. Students learn that wind, water, living organisms, and gravity break rocks into smaller particles and move them around.		
Narrative / Background Information		
Prior Student Knowledge: ● 2-ESS1-1 Earth's Place in the Universe: Use information from several sources to provide evidence that Earth events can occur quickly or slowly.		
Planning and Carrying Out Investigations · Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) **Analyzing and Interpreting Data** · Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)	**ESS1.C: The History of Planet Earth** · Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1) **ESS2.A: Earth Materials and Systems** · Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.E: Biogeology** · Living things affect the physical characteristics of their regions. (4-ESS2-1)	**Cause and Effect** · Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1) **Patterns** · Patterns can be used as evidence to support an explanation. (4-ESS1-1) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** · Science assumes consistent patterns in natural systems. (4-ESS1-1)

Possible Preconceptions/Misconceptions:
Students may not realize that even something as hard as rocks can be broken down. There are many ways that weathering occurs, not just rocks tumbling down a mountain.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Causes of Erosion	**Lesson # _2_ in a series of _5_ lessons**

Brief Lesson Description: The purpose of this lesson is to give students the opportunity to investigate how the different causes of erosion (water, ice, and wind) can affect the land. They will do this by working in groups to complete an exploration/lab using sand and models to represent the forces of erosion. This lesson will likely take two science periods.

Performance Expectation(s): Students work in their models to slow down the rate of erosion. Ask students to think about the limitations of the model they have been working on for this exploration. Example: toothpicks/popsicle sticks do not have roots like plants have.

Specific Learning Outcomes: Students will work collaboratively to determine the effects of erosion by modeling different causes of erosion (water, wind) on piles of sand.

Narrative / Background Information

Prior Student Knowledge:

- In the previous lesson students began to explore the process of weathering. Students modeled this process.

Planning and Carrying Out Investigations · **Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)** **Constructing Explanations and Designing Solutions** . · **Identify the evidence that supports particular points in an explanation. (4-ESS1-1)**	**ESS2.A: Earth Materials and Systems** · Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.E: Biogeology** · Living things affect the physical characteristics of their regions. (4-ESS2-1) **ESS1.C: The History of Planet Earth** · Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as	**Cause and Effect** · Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1) **Patterns** · Patterns can be used as evidence to support an explanation. (4-ESS1-1) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** · Science assumes consistent patterns in natural systems. (4-ESS1-1)

	earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)	

Possible Preconceptions/Misconceptions:

Erosion can be prevented. Erosion can only occur through wind and water.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Weathering and Erosion	**Lesson # _3_ in a series of _5_ lessons**

Brief Lesson Description: In this lesson, students working in teams are presented with a problem statement. Students will go through a series of learning stations with their team to learn more background information about weathering, erosion, and deposition. Teams will then use what they have learned to brainstorm ways to slow the effects of coastal erosion. This lesson will likely take three science periods.

Performance Expectation(s): Students will identify weathering, erosion and deposition through the use of pictures and begin to develop scientific understandings of possible solutions. Students will read through excerpts and create visual models.

Specific Learning Outcomes: Students will read information cards about the causes of weathering, erosion, and deposition. Students will learn that weathering is the process of breaking down sediments, erosion is the movement of sediments, and deposition occurs when sediments are dropped to new places. Students will then record how each force affects the earth's surface.

Narrative / Background Information

Prior Student Knowledge:

- Students have modeled forms of erosion using sugar cubes and sand.
- Wind, ice, water erosion can be identified and recognized in pictures.

Planning and Carrying Out Investigations · **Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)** **Constructing Explanations and Designing Solutions** . · **Identify the evidence that supports particular points in an explanation. (4-ESS1-1)**	**ESS2.A: Earth Materials and Systems** · Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.E: Biogeology** · Living things affect the physical characteristics of their regions. (4-ESS2-1)	**Cause and Effect** · Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1) **Patterns** · Patterns can be used as evidence to support an explanation. (4-ESS1-1) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** · Science assumes consistent patterns in

	ESS1.C: The History of Planet Earth · Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)	natural systems. (4-ESS1-1)

Possible Preconceptions/Misconceptions:

Students may inaccurately use the terms weathering, erosion, and deposition as these are newer vocabulary words.

LESSON PLAN – 5-E Model

Grade/ Grade Band: 4	**Topic:** Coastal Erosion STEM Challenge	**Lesson # _4_ in a series of _5_ lessons**

Brief Lesson Description: Students will study current shoreline structures that help to slow the effects of coastal erosion. Students will then be given a specific scenario related to coastal erosion and work in design teams to plan and model a potential solution for their scenario. This lesson will likely take five science periods.

Performance Expectation(s): Students will use their prior observations and understandings of erosion as well as what they learn about current structures that help prevent erosion to plan and model a solution for a given coastal erosion scenario.

Specific Learning Outcomes: Students will design a process to slow down coastal erosion of beaches using the engineering design process.

Narrative / Background Information

Prior Student Knowledge:

- K-2-ETS1-3 Engineering Design: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
- 2-ESS2-1 Earth's Systems: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Planning and Carrying Out Investigations · **Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)** **Constructing Explanations and Designing Solutions**	**ESS2.A: Earth Materials and Systems** · Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them	**Cause and Effect** · Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1) **Patterns** · Patterns can be used as evidence to support an explanation. (4-ESS1-1) -

. · **Identify the evidence that supports particular points in an explanation. (4-ESS1-1)**	around. (4-ESS2-1) **ESS2.E: Biogeology** · Living things affect the physical characteristics of their regions. (4-ESS2-1) **ESS1.C: The History of Planet Earth** · Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)	***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** · Science assumes consistent patterns in natural systems. (4-ESS1-1)
Possible Preconceptions/Misconceptions: ● Erosion can happen quickly. ● Erosion can be stopped and only happens with rain. ● Students should also consider how their solution will impact the people in the community.		
LESSON PLAN – 5-E Model		

Grade/ Grade Band: 4	**Topic:** Rock Layers	**Lesson # _5_ in a series of _5_ lessons**
Brief Lesson Description: In this lesson, students view an image of rock layers and use this image to construct an explanation about how the land has changed over time.		
Performance Expectation(s): Students work in partnerships or with their team to describe what they see, think, and wonder about an image. Students then construct an explanation about how the land has changed over time.		
Specific Learning Outcomes: Students learn that fossils indicate the order in which rock layers were formed. Patterns are used as evidence to support an explanation.		
Narrative / Background Information		
Prior Student Knowledge: ● 3-LS4-1: Some kinds of plants and animals that once lived on Earth are no longer found anywhere. ● 3-LS4-1: Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.		
Constructing Explanations and Designing Solutions · **Identify the evidence that supports particular points in an explanation. (4-ESS1-1)**	**ESS1.C: The History of Planet Earth** · Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as	**Patterns** · Patterns can be used as evidence to support an explanation. (4-ESS1-1) - ***Connections to Nature of Science***

	earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems** · Science assumes consistent patterns in natural systems. (4-ESS1-1)

Possible Preconceptions/Misconceptions:

Conceptualizing changing landforms may be challenging for students.

LESSON PLAN – 5-E Model

Teacher Professional Learning Resources

Teaching NGSS in Elementary School-Fourth Grade

The web seminar began with an introduction to NGSS, its framework for K-12 science education, and its cross-cutting concepts and core ideas by NSTA's Ted Willard. Mary Starr, Executive Director of Michigan Mathematics and Science Centers Network and Kathy Renfrew, K-5 Science Coordinator for VT Agency, began with a look into disciplinary core ideas, using the example of energy, and how they apply to the fourth grade in terms of performance expectations and an approach to science and engineering practices. Kathy also brought a special guest with her, Tracy Lavallee, a teacher from Vermont featured in the web seminar's videos. Using two videos taken from Tracy's fourth grade classroom, lesson plan ideas and approaches were discussed and teachers were able to share their thoughts and approaches on the classroom activities. A number of NSTA Learning Center tools and resources were shared as well a number of website links for further investigation. The session concluded with some final words from Ted and a Q/A.

Visit the resource collection.

Continue discussing this topic in the community forums.

NSTA Web Seminar: Teaching NGSS in K-5: Constructing Explanations from Evidence

Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the *NGSS* for K-5th grade. The web seminar focused on the three dimensional learning of the *NGSS*, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.

To view related resources, visit the resource collection.

Continue discussing this topic in the community forums.

NGSS *Core* Ideas: Earth's Place in the Universe

The presenter was Julia Plummer from Penn State University. The program featured strategies for teaching about Earth science concepts that answer questions such as "What goes on in stars?" and "What patterns are caused by Earth's movements in the solar system?"

Dr. Plummer began the presentation by discussing what students should know about the disciplinary core idea of Earth's Place in the Universe. She talked about using the scientific and engineering practices to help engage students. Participants shared their ideas about applying this core idea to the classroom, and then Dr. Plummer shared strategies for effective instruction. She also discussed the importance of spatial thinking for students to begin thinking scientifically about these concepts.

Continue the discussion in the community forums.