GRADE 4

Science Curriculum

Oradell Public School District

Oradell, NJ

2023

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Oradell Public School District

Grade 4 Science Curriculum Committee Credits:

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Board Policy

This revision is aligned with the New Jersey Student Learning Standards for Science, the New Jersey Student Learning Standards for Computer Science and Design Thinking, the New Jersey Student Learning Standards for Career Readiness, Life Literacies, and Key Skills, and includes connections to Social-Emotional Learning Competencies.

Affirmative Action

During the development of this course of study, particular attention was paid to the elimination or exclusion of any materials which might discriminate on the basis of race, color, national origin, ancestry, age, sex, affectional or sexual orientation, gender identity or expression, marital status, familial status, genetic information, mental or physical disabilities, or in educational opportunities. Every effort has been made to uphold both the letter and spirit of Affirmative Action mandates as applied to the content, the texts and the instruction inherent in this course.

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The Science curriculum was developed by the Oradell School District and aligned to the

New Jersey Student Learning Standards (NJSLS).

Oradell Public School District

Suggested Pacing Guide for Science
Grade 4

Unit	Approximate Months	Unit	Skills
1	Sept-Oct	Physical Science	Energy
2	Nov-Dec	Physical Science	Waves: Waves and Information
3	Jan-Mar	Life Science	Structure and Function
4	Apr-Jun	Earth & Space Science	Earth's Systems Processes that Shape the Earth
Appendix A			3-5 Engineering Design Standards

Grade 4 Science Curriculum

Unit 1: Physical Science: Energy

Unit Overview

Excerpts below are from NJ State model curriculum, Units 5 & 6- "What it looks like in the classroom"

Forces and Motion- *NJ Model Curriculum, Unit 6*

In order to understand and explain the relationship between an object's speed and its energy, students need multiple opportunities to observe objects in motion. Students can roll balls down ramps, build and race rubber band cars, or build roller coasters. As they observe the motion of objects, they should collect data about the relative speed of objects in relation to the strength of the force applied to them. For example, when a ball is placed at the top of a ramp, it has stored energy, due to the force of gravity acting on it. When the ball is released, that stored energy is changed (transferred) into motion energy. Increasing the height of a ramp also increases the amount of stored energy in the ball at the top of the ramp. If the ball is released from a higher starting point, it rolls faster and farther. Likewise, winding the rubber band in a rubber band car stores energy in the rubber band, which is then changed, or transferred, into motion energy (kinetic) as the car moves forward. The more times you wind the rubber band, the greater the amount of stored energy in the rubber band, and the farther and faster the car goes. As students investigate these types of force and motion systems, they should conduct multiple trials, increasing and decreasing the amount of energy, then collect qualitative data as they observe the impact differing amounts of energy have on the relative speed of the object in motion. Students should then use their data as evidence to support their explanation of the relationship between the relative speed of an object and its energy.

Once students understand that the faster an object moves, the more energy it possesses, they can begin to explore ways in which energy can be transferred. As they investigated the relationship between speed and energy, students learned that stored energy was changed, or transferred, into motion energy. To broaden their understanding of energy transfer, students should be provided with opportunities to observe objects colliding and should be encouraged to ask questions that lead to further investigation. For example, if students roll a ball towards a wall, or roll two balls so that they collide, they may observe any or all of the following:

- Change(s) in the direction of motion
- Change(s) in speed
- Change(s) in the type of energy (e.g., motion energy to sound energy, sound energy to heat energy)
- Change(s) in the type of motion (rolling to bouncing).

As students continue to investigate interactions between moving objects, they should notice that when a moving object collides with a stationary object, some of the motion energy of one is transferred to the other. In addition, some of the motion energy is changed, or transferred to the surrounding air, and as a result, the air gets heated and sound is produced. Likewise, when two moving objects collide, they transfer motion energy to one another and to the surrounding environment as sound and heat. It is important that as students observe these types of interactions, they collect observational data, document the types of changes they observe, look for patterns of change in both the motion of objects and in the types of energy transfers that occur, and make predictions about the future motion of objects. Their investigations will help them understand that:

- Energy can be transferred in various ways and between objects.
- Energy is present whenever there are moving objects.
- Energy can be moved, or transferred, from place to place by moving objects.

When objects collide, some energy may be changed or transferred into other types of energy.

Energy- *NJ Model Curriculum, Unit 5*

Students conduct investigations to observe that energy can be transferred from place to place by sound, light, heat, and electrical currents. They describe that energy and fuels are derived from natural resources and that their uses affect the environment. Throughout this unit, students obtain, evaluate, and communicate information as they examine cause-and-effect relationships between energy and matter.

To begin the unit of study‘s progression of learning, students need opportunities to observe the transfer of heat energy. They can conduct simple investigations, using thermometers to measure changes in temperature as heat energy is transferred from a warmer object to a colder one. For example, hot water can be poured into a large Styrofoam cup, and then a smaller plastic cup of cold water can be placed inside the larger cup of water. A thermometer can be placed in each cup, and students can observe and record changes in the temperature of the water in each cup every minute over the course of about 10–15 minutes, or until the temperatures are the same. Students can use their data as evidence to explain that some of the heat energy from the hot water transferred to the cold water. This transfer of heat caused the cold water to become gradually warmer and the hot water to cool. This process continued until the cups of water reached the same temperature.

Students can also place a thermometer in the palm of their hands, close their hands around it, and measure the temperature. They can then place a piece or two of ice into their palms and close their fists around the ice until it melts. When they again measure the temperature of their palms,

they will observe a change. Students can use these data to describe how some of the heat from their hands transferred to the ice, causing it to melt, while the ice also decreased the temperature of their hand. It is important that students understand that heat is transferred from warmer to colder objects. When an object cools, it loses heat energy. When an object gets warmer, it gains heat energy.

To continue learning about energy transfer, students can build simple electric circuits. As students work in small groups to build circuits, they should add a bulb and/or a buzzer to the circuit in order to observe and describe the ways in which energy is transferred in the circuit. (The word “transfer” can refer to a change in the type of energy or a change in the location of energy.) For example, stored energy in a battery is transferred into electrical energy, which is then transferred into light energy if a bulb is added to the circuit. The energy transfers from the battery to the wire and then to the bulb. The same holds true if a buzzer is added to the circuit. The stored energy in the battery is transferred into electrical energy, which is then transferred into sound energy. (Keep in mind that energy is not actually produced. When we say that energy is “produced,” this typically refers to the conversion of stored energy into a desired form for practical use. Students should be encouraged to use the term “transferred” rather than “produced”).

After conducting these types of investigations, the class can create a list of events in which energy is transferred. For example, when a ball is thrown against a wall, some of the motion energy is transferred to sound energy; when water boils on the stove top, heat energy from the stove is transferred to the pot and to the water in the pot; and when a doorbell is rung, electrical energy is transferred into sound energy.

Next, students learn about fuels and energy, and conduct research using books and other reliable media to determine which natural resources are sources of energy. Light, heat, sound, and electricity are all forms of energy. Energy is not matter. Fuels, however, are matter. For example, fossil fuels, such as coal, oil, and natural gas, are matter. When fossil fuels are burned, energy stored in the fuel can be transferred from stored energy to heat, light, electrical, and/or motion energy. Therefore, fuels are considered to be a source of energy.

Energy can also be obtained from other sources, such as wind, water, and sunlight. Air and water are both matter, but when they are moving, they have motion energy. Energy from wind (moving air) and from moving water can be transferred into electrical energy. Light energy from the sun can also be transferred to heat energy or electrical energy. In addition, energy can be released through nuclear fission using materials known as fissile materials.

As students learn about fuels and other sources of energy, they should determine which sources are renewable and which are nonrenewable. Generally, a fuel or source of energy is considered nonrenewable if that source is limited in supply and cannot be replenished by natural means within a reasonable amount of time. Renewable sources of energy are those that are replenished

constantly by natural means. Using this general description, all fossil fuels are considered nonrenewable, because these resources were naturally created over millions of years. Fissile materials are also nonrenewable. On the other hand, wind, moving water, and sunlight are renewable sources of energy.

As the population continues to grow, so does the demand for energy. Human use of natural resources for energy, however, has multiple effects on the environment. Students should conduct further research to determine how the use of renewable and nonrenewable resources affects the environment.

Some examples include:

- Changes in and loss of natural habitat due to the building of dams and the change in the flow of water;
- Changes in and loss of natural habitat due to surface mining; and
- Air pollution caused by the burning of fossil fuels in factories, cars, and homes.

As students conduct research and gather information from a variety of reliable resources, they can take notes and use the information to describe and explain the impact that human use of natural resources has on the environment.

Big Idea/Common Thread:

- Energy is the ability to do work or cause change. A relationship exists between the speed of an object and the energy of that object. Energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. Understanding how energy works can help one to design, test, and refine a device that converts energy from one form to another.

Enduring Understanding:

- Moving objects contain energy.
    - The faster the object moves, the more energy it has.
    - Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents.
    - Energy can be converted from one form to another form.
- When objects collide, contact forces transfer energy so as to change the objects' motions.
- Energy can be "produced," "used," or "released" by converting stored energy.
- Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.

Essential Questions:

- What is energy and how is it related to motion?
- How is energy transferred?
- How can energy be used to solve a problem?

Assessments

Possible Ongoing Formative Assessments
• Wrap It Up! Questions • Various levels of questioning • Teacher Observation • Student Observation • Class Discussions/Partner Talk • Science Notebook activities • Performance Expectation Activities: Investigate; Think Like a Scientist; Think Like an Engineer, STEAM Projects • Teacher Rubrics for Performance Expectations Activities • Hands-on labs
Summative Assessments
• Energy Science Unit Assessment (Physical Science)
Alternative Assessments
• Modified Energy Science Unit Assessment (Less answer choices, highlighted vocabulary, etc.)

Standards (NJSLS) Addressed in this Unit

Disciplinary Core Ideas

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-PS3-2),(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 and sound is produced. (4-PS3-2),(4-PS3-3)
  - Light also transfers energy from place to place. (4-PS3-2)
  - 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-PS3-2),(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)

- **ESS3.A: Natural Resources**
  - 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. (4-ESS3-1)

- **ETS1.A: Defining 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. (secondary to 4-PS3-4)

Crosscutting Concepts

- **Cause and Effect**
  - Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

- **Energy and Matter**
  - Energy can be transferred in various ways and between objects. (4-PS3-1), (4-PS3-2),(4-PS3-3),(4-PS3-4)

Science and Engineering Practices

- **Asking Questions and Defining Problems**
  - Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.
  - Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

- **Planning and Carrying Out Investigations**
  - Planning and carrying out investigations to answer questions or test solutions to

problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
    - 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)

- **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.
    - Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)
    - Apply scientific ideas to solve design problems. (4- PS3-4)

- **Obtaining, Evaluating, and Communicating Information**
    - Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.
    - Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

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-ESS3-1)

Influence of Engineering, Technology, and Science on Society and the Natural World
- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
- 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)

Computer Science and Design Thinking

8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from

different views of the data
8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
8.2.5.ED.1: Explain the functions of a system and its subsystems
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.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have

Career Readiness, Life Literacies, and Key Skills

CAREER AWARENESS, EXPLORATION, PREPARATION, AND TRAINING
● 9.2.5.CAP.4 - Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

LIFE LITERACY AND KEY SKILLS
● 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 (e.g., W.4.7, 8.2.5.ED.6).
● 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.2 - Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
● 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).
● 9.4.5.DC.8 - Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).

PRACTICES
● CLKSP1 - Act as a responsible and contributing community member and employee.

● CLKSP4 - Demonstrate creativity and innovation.
● CLKSP5 - Utilize critical thinking to make sense of problems and persevere in solving them.

Interdisciplinary Connections:

English Language Arts

Reading- Informational
● RI.4.1 - Refer to details and examples in a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
● 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.
● RI.4.9 - Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from two texts on the same topic in order to write or speak about the subject knowledgeably.

Writing
● W.4.2 - Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
● 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.

Speaking and Listening
● 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.
● SL.4.4 - Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Mathematics
Mathematical Practices
● MP.2 - Reason abstractly and quantitatively
● MP.4 - Model with mathematics

Operations and Algebraic Thinking
● 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.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.

Social-Emotional Competencies

- **Self-Awareness**: ability to recognize one's emotions and know one's strengths and limitations
    - Connections:
        - Regular check-ins to share feelings (Oral, Thumbs Up, Thumbs Down, Emojis, etc.)
        - Reflecting on one's learning (Oral, Thumbs Up, Thumbs Down, Pictures, etc.)

- **Self-Management**: ability to regulate and control one's emotions and behaviors, particularly in stressful situations
    - Connections:
        - Take a brain break and dance to ROYGBIV GoNoodle Video
        - Playing soft music/deep breathing - Sounds of Nature
        - Use of cool down spot in classroom

- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one's actions influence and are influenced by others
    - Connections:
        - Students helping each other during small group work
        - Write positive comments on student projects

- **Relationship Skills**: refers to one's ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
    - Connections:
        - Class discussions
        - Incentives for individual students and small groups

- **Responsible Decision-Making**: refers to the ability to use multiple pieces of information to make ethical and responsible decisions

- Connections:
  - Class rules and routines
  - Class discussions
  - Following directions

UNIT OBJECTIVES

Students will be able to …

- **Use evidence to construct an explanation relating the speed of an object to the energy of that object. (4-PS3-1)**
  [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.]

Disciplinary Ideas

- Understand that the faster a given object is moving, the more energy it possesses.

Crosscutting Concepts

- Recognize that energy can be transferred in various ways and between objects.

Science and Engineering Practices

- Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

4-PS3-1

Concepts	Students can...
• The faster a given object is moving, the more energy it possesses. • Energy can be transferred in various ways and between objects • Apply scientific ideas to solve design problems.	• Connect the speed of a moving object to the amount of energy it possesses. • Explain how energy can be moved from place to place by moving objects. • Use evidence to explain how the speed of an object relates to its energy.

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. (4-PS3-2)
  [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

Disciplinary Ideas

- Understand that energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- Understand that 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.
- Understand that light also transfers energy from place to place.
- Understand that 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.

Crosscutting Concepts
- Recognize that energy can be transferred in various ways and between objects

Science and Engineering Practices
- 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.

Concepts	Students can...

• Energy can be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.
• 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.
• Light can transfer energy from place to place
• Energy can be transferred in various ways and between objects
• Observations serve as evidence, used to explain a scientific concept or test a design solution.
	• Recall that moving objects possess energy
	• Describe the transfer of energy that occurs when moving objects collide.
	• Make an inference about energy conservation during a collision.
	• Define domain-specific vocabulary
	  ○ electrical circuit
	  ○ electrical energy
	  ○ thermal energy
	• Recognize that the transfer of electrical energy as current requires a complete circuit
	• Recognize that light, sound and electrical current possess and transfer energy
	• Implement an experimental investigation to test one variable-the object/material that completes an electrical circuit
	• Make observations to provide evidence that energy can be transferred from place to place
	  ○ Heat (thermal energy)
	  ○ Sound
	  ○ Electrical current

Students will be able to …

- Ask questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3)
  [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.]

Disciplinary Ideas

- Understand that energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- Understand that 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.
- Understand that when objects collide, the contact forces transfer energy so as to change the objects' motions.

Crosscutting Concepts

- Recognize that energy can be transferred in various ways and between objects.

Science and Engineering Practices

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships

4-PS3-3

Concepts	Students can...

• Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
• When objects collide, energy can be transferred from one object to another, thereby changing their motion.
• When objects collide, the contact forces transfer energy so as to change the objects' motions.
• Energy can be transferred in various ways and between objects
	• Describe the transfer of energy that occurs when moving objects collide.
	  ○ Ask questions about the challenges in energy that occur when objects collide
	  ○ Predict outcomes about the changes in energy that occur when objects collide
	  ○ Make an inference about energy conservation during a collision
	• Recognize that moving objects possess and transfer energy

Students will be able to …

- Apply scientific ideas to design, test, and refine a device that converts energy from one

form to another.* (4-PS3-4)
[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.]

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. See Appendix A, 3-5 Engineering Design.

Disciplinary Ideas

- Understand that 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.
- Understand that the expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

Crosscutting Concepts

- Recognize that energy can be transferred in various ways and between objects.

Science and Engineering Practices

- Apply scientific ideas to solve design problems

4-PS3-4

Concepts	Students can...
• Energy can be transferred from place to place by electric currents, which can then produce motion, sound, heat, or light. • Energy can be transferred in various ways and between objects • 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).	• Understand that energy can be transferred from place to place by electric currents, which can then produce motion, sound, heat, or light • Understand that produced energy can be stored and transferred for practical use • Define a design problem that includes specified criteria for success and constraints • Plan and carry out a fair test to identify aspects of a prototype that can be improved • Apply scientific ideas to design, test, and refine a device that converts energy from one form to another

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. (4-ESS3-1)
  [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.]

Disciplinary Ideas

- Understand that 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

- Recognize that cause and effect relationships are routinely identified and used to explain change.

Science and Engineering Practices

- Obtain and combine information from books and other reliable media to explain phenomena.

4-ESS3-1

Concepts	Students can...
• 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. • The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. • Currents may be produced by transforming the energy of motion into electrical energy. (i.e. wind energy as in windmills, water energy as in dams) • Cause and effect relationships are routinely identified and used to explain change • Scientific concepts/phenomena can be explained by observation and reliable media	• Explain what the expression “produce energy” refers to. • List energy resources derived from natural sources that are and are not renewable over time. • Understand that the energy we use for electricity and transportation has to come from another source. • Compare the effects different energy resources have on the environment. • Obtain and combine information to describe that energy is derived from natural resources and their uses affect the environment.

SUGGESTED ACTIVITIES

- ***BILL NYE THE SCIENCE GUY - MOTION*** This episode explains the basics of motion and push/pull forces. https://www.dailymotion.com/video/x4f1skg

- ***FORMS OF ENERGY*** In this BrainPOP movie, Tim and Moby introduce you to the different forms of energy. You'll learn the difference between these types, like potential energy and kinetic energy, plus how one form of energy can transform into another. Discover what kind of energy is stored in food and helps you walk and run. Find out what forms of energy we get from the sun, batteries, and power plants, as well as which types airplanes, wind, moving water, and sound waves all have. www.brainpop.com

- ***ENERGY SOURCES*** Tim and Moby introduce you to energy sources and basic methods of energy production. You'll learn where energy comes from, how motion is converted into electricity, and how we use generators to create energy. Discover how water and wind can create mechanical energy and how the sun and earth help us do everything from heat our homes to get work done. Find out how fossil fuels generate energy, and the problems that overusing them can bring. www.brainpop.com

- ***CONSERVING ENERGY*** Tim and Moby explain why Earth's dwindling supply of non-renewable resources--along with the harmful gases they produce--makes conservation so important. You'll also learn why insulating and weatherizing your home can save you money and protect the environment, and how simple things like air-drying laundry on a clothesline can really make a difference. www.brainpop.com

- *The Boy Who Harnessed the Wind* 4-PS3-4 This article from Science and Children provides ideas for using the trade book, The Boy Who Harnessed the Wind, as a foundation for a lesson on generators. This beautiful book is the inspiring true story of a teenager in Malawi who built a generator from found materials to create much-needed electricity. The lesson allows students to explore the concept of energy transfer using crank generators. Students then design improvements to the crank mechanism on the generator. The lesson may be extended by having students build their own generators.

  Hand Crank Generators:
  https://www.facebook.com/cmhouston/videos/welcome-to-the-hand-crank-generators/1457970038031092/

- ***DESIGN A LUNAR THERMOS*** 4-PS3-2 This engineering lesson is part of *An Educator's Guide to the Engineering Design Process Grades 3-5* created by NASA to guide students in understanding how humans can be protected from the temperature variations found on the Moon. To understand the challenge of keeping a human body at a fairly constant temperature in a space suit, students are challenged to design an insulator for a cup of hot water and a cup of cold water that can maintain a relatively constant water temperature. Following the Engineering Design Process and the science of heat and energy transfer, students work in teams to design their own *Lunar Thermos*. Design a Lunar Thermos

- ***SLED WARS*** 4-PS3-3 Sled Wars is an interactive simulation that allows students to explore what happens when objects collide. By crashing a virtual sled into a row of snowmen, students can observe how variables affect energy transfer in a collision. They can change the mass of the sled's rider or the launch height to increase the amount of energy, thus increasing the number of snowmen that can be knocked over. http://ngss.nsta.org/Resource.aspx?ResourceID=434

- ***SQUISHY CIRCUITS*** 4-PS3-2 This resource provides recipes for conductive and insulating dough that students can use to build squishy circuits. Students learn that a closed circuit is needed in order for electricity to flow from the battery pack to light the bulb.Once the concept of electrical circuits transferring energy has been understood students explore the transfer of energy to other forms through the addition of light bulbs, motors and buzzers to their circuits. Squishy Circuits

- ***FEEL THE HEAT*** 4-PS3-4 In Feel the Heat, students follow the engineering design process to build a solar hot water heater and redesign their device to see how big a temperature change they can get by changing different variables. The phenomenon of energy transfer can be a challenging concept for upper elementary students, however, this activity provides the students with the opportunity to use their investigation data to improve their heater to increase the temperature of the water. This lesson contains elements that are appropriate for middle school(convection/conduction/radiation), but the basic premise of the lesson, that solar energy can be used to heat water, is appropriate for upper elementary. Teachers can decide to use a gooseneck lamp with an indoor 100-watt floodlight as the energy source for the student water devices (safely precautions tips included), or they can choose to work outside with the sun as the natural energy source. Feel The Heat
- ***TRANSFER OF ENERGY*** Four activities that demonstrate a transfer of energy from one material to the other. Transfer of Energy-Moving Pennies-NGSS 4th https://www.generationgenius.com/videolessons/energy-transfer-video-for-kids/

- ***COMMUNITY UTILITIES*** Have students research the source of your local utility company's electricity. Is it coal, natural gas, hydro, nuclear, wind or some combination? Many local utility companies provide detailed websites and extensive K-12 outreach programs for schools. A representative may even come to your classroom or lead a field trip.
  https://www.pseg.com/info/community/new_site/index.jsp
  https://www.oru.com/en

- ***TEACH ENGINEERING*** With an introduction to the ideas of energy, students discuss specific types of energy and the practical sources of energy. Hands-on activities help them identify types of energy in their surroundings and enhance their understanding of energy.
  What Is Energy? - Lesson - TeachEngineering

Unit Specific Vocabulary
motion - when an object is moving, it is in motion **transfer -** to transfer is to pass from one object to another **vibrations -** rapid back-and-forth movements **transform -** to transform is to change **thermal energy -** thermal energy is the energy of heat **electrical energy -** electrical energy is the energy of charged particles **electric current -** electrical current is the transfer of electrical energy through a material **electric circuit -** an electric circuit is a complete path through which an electric current can pass **energy of motion -** energy of motion is the energy that is present when an object moves **fossil fuel -** a fossil fuel is a source of energy that formed from the remains of plants and animals that lived millions of years ago **nonrenewable energy resource -** a nonrenewable energy source is an energy source that will eventually run out **renewable energy resources -** a renewable energy source is an energy source that will never run out **solar energy -** solar energy is heat and light energy from the sun **wind energy -** wind energy is from the wind

Instructional Materials and Learning Activities
Core Instructional Materials: ● *National Geographic Exploring Science 4* ● *National Geographic My NG connect Exploring Science 4 Digital Resources* ● *National Geographic Exploring Science through Literacy*

- *Hand2Mind Exploring Science Hands on Kit*

Digital Resources:

- Access the Next Generation Science Standards by Topic - The NGSS Standards
- http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas
- https://www.teachengineering.org lessons ideas
- https://www.generationgenius.com/

Supplemental Materials:

- Discovery Education: Streaming Plus & Science Tech Book

Leveled Readers:

Level Reader	Below-Level	On-Level	Above-Level
Exploring the Coral Reefs	690L	820L	910L
The Good Earth	730L	820L	920L

Suggested Modifications

These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.

NGSS Appendix D - "All Students, All Students": Making the Next Generation Science Standards Accessible to All Students

Special Education Students

- To help students understand how the biodigester produces energy, help them create a sequence graphic organizer to show the energy transfers and transformations involved. Start with the sun, and include plants, animals, and waste. End with electrical energy.
- To help students understand the pathway of energy from dead plants or animals to electricity, create a large sequential graphic organizer on the board that shows each step along the way. Some steps you may include are: 1. plants and animals; 2. fossil fuels; 3. steam; 4. turning blades of turbine; 5. electricity. Have students copy the steps in their notebook and write their own descriptions of the transitions from each to the next.
- Ask either/or questions to help students explain how electricity is generated. *For example: Do generators transfer or transform energy of motion into electricity? (transform); For example: Do the villagers need an energy source or construction materials?*
- Extended time for assignment
- Prompting
- Reassurance

- Time to formulate ideas
- Use of visual clues when reading
- Preferential seating
- Repeated directions
- Instructional Aides in the classroom setting
- Peer models
- Preview content vocabulary and schema
- Use of FM system to improve attention and support auditory information
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Graphic organizers

Students at Risk

- To help students understand how the biodigester produces energy, help them create a sequence graphic organizer to show the energy transfers and transformations involved. Start with the sun, and include plants, animals, and waste. End with electrical energy.
- To help students understand the pathway of energy from dead plants or animals to electricity, create a large sequential graphic organizer on the board that shows each step along the way. Some steps you may include are: 1. plants and animals; 2. fossil fuels; 3. steam; 4. turning blades of turbine; 5. electricity. Have students copy the steps in their notebook and write their own descriptions of the transitions from each to the next.
- Provide sentence frames to help students explain how electricity is generated. *For example: Generators transform (motion) energy into (electrical) energy.* Provide language frames to help students identify the problem. *For example: The villagers need (sustainable) energy.*
- Provide sentence stems to help students explain how electricity is generated. *For example: Wind and moving water have . . .Generators transform . . .*Provide sentence stems to help students identify the problem. *For example: The villagers need . . .*
- Response to intervention - targeted skill/goal improvement plans within a set time frame
- Multisensory manipulatives
- Preferential seating
- Behavior chart to increase focus and work completion
- Use of FM system to improve attention and support auditory information
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Leveled texts
- Audio books
- Consultation with academic support teachers to address skills identified by the classroom teacher
- Modification of assignments and assessments
- Splitting up open ended components of assessments into manageable tasks

English Language Learners

- Ask either/or questions to help students explain how electricity is generated. *For example: Do generators transfer or transform energy of motion into electricity? (transform); For example: Do the*

villagers need an energy source or construction materials?

- Provide sentence frames to help students explain how electricity is generated. *For example: Generators transform (motion) energy into (electrical) energy.* Provide language frames to help students identify the problem. *For example: The villagers need (sustainable) energy.*
- Provide sentence stems to help students explain how electricity is generated. *For example: Wind and moving water have . . .Generators transform . . .*Provide sentence stems to help students identify the problem. *For example: The villagers need . . .*
- Collaborate with English Language teacher. Preview content vocabulary *(with pictures and labels in the student's first language)*
- Visual clues (pictures)
- Repeated directions
- Check for understanding
- Ask pointed questions
- Peer models
- English language supports for parents of non English speaking students
- Use of iPad for translation between English and the student's first language
- Materials presented at lower TC levels
- Audio books
- Use of interactive English vocabulary websites *(Learning Chocolate)*
- Small flip book of content specific vocabulary with translations and pictures

Gifted and Talented

- Have students create their own graphic organizer to show the steps of energy transfer and transformation that result in electrical energy from a biodigester.
- Have students create and label diagrams with the types of energy, energy transfers, and energy transformations involved.
- Challenge questions and higher level thinking while reading both fiction and nonfiction texts
- Higher TC level texts
- Advanced STEAM activities
- Assigned leadership roles within class

Students with 504 Plans

- To help students understand how the biodigester produces energy, help them create a sequence graphic organizer to show the energy transfers and transformations involved. Start with the sun, and include plants, animals, and waste. End with electrical energy.
- To help students understand the pathway of energy from dead plants or animals to electricity, create a large sequential graphic organizer on the board that shows each step along the way. Some steps you may include are: 1. plants and animals; 2. fossil fuels; 3. steam; 4. turning blades of turbine; 5. electricity. Have students copy the steps in their notebook and write their own descriptions of the transitions from each to the next.
- Provide sentence frames to help students explain how electricity is generated. *For example: Generators transform (motion) energy into (electrical) energy.* Provide language frames to help students identify the problem. *For example: The villagers need (sustainable) energy.*
- Provide sentence stems to help students explain how electricity is generated. *For example: Wind*

*and moving water have . . .Generators transform . . .*Provide sentence stems to help students identify the problem. *For example: The villagers need . . .*

- Extended time for assignment
- Prompting
- Reassurance
- Time to formulate ideas
- Use of visual clues when reading
- Preferential seating
- Repeated directions
- Instructional Aides in the classroom setting
- Peer models
- Preview content vocabulary and schema
- Use of FM system to improve attention and support auditory information
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Graphic organizers

Grade 4 Science Curriculum

Unit 2: Physical Science- Waves: Waves and Information

Unit Overview

Excerpt from NJ State model curriculum, Unit 8, "What it looks like in the classroom"

In this unit of study, students plan and carry out investigations, analyze and interpret data, and construct explanations. They also develop and use models to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move.

Waves, which are regular patterns of motion, can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). Students can model the properties of waves by disturbing the surface of water in a variety of pans and buckets. Students should make observations as they strike the surface of the water with small and large objects, such as marbles and rocks. In addition, smaller pans can be tilted in different directions in order to observe the effect on the wave patterns created on the surface of the water. Students should observe and describe a number of similarities and differences in the wave patterns created, including the following:

- When an object hits the surface of water, waves move across the surface.
- Waves move up and down across the surface of the water away from the point of contact.
- Waves on the surface of the water move away from the point of contact in increasingly larger circles.
- When waves hit another surface, the waves change direction and move away from the surface with which they come into contact.
- The height of the wave (amplitude) and the distance between the peaks of waves (wavelength) varies depending upon the intensity of the disturbance, and/or the size (mass, volume) of the object disturbing the surface of the water.

When describing the properties of waves, students should also develop a model using drawings, diagrams, or physical models (such as a slinky or jump rope) to show the basic properties of waves (amplitude and wavelength). In addition, the class should discuss other real-world examples of waves, including sound and light waves, using understandings developed in prior units of study.

To begin the engineering design process, students are challenged to design a way to use patterns to transfer information. This process should include the following steps:

- As a class, brainstorm a list of ways in which patterns have been used in the past to communicate over distance. Some examples include the use of smoke signals, drums, and Morse code on a telegraph.
- Small groups collaboratively conduct research to determine other possible ways of communicating using patterns over distances.
- As a class, determine criteria and possible constraints on the design solutions.
- Criteria might include that groups must communicate information using patterns, the design solution must communicate over a predetermined distance, and groups must be able to describe how patterns were used in the design to communicate over a distance.
- Possible constraints might include materials available to build/create a device and the amount of time available to design and build.
- Small groups work collaboratively to design and build a device or design a process for communicating information over a distance. Some examples could include:
- Drums sending coded information through sound waves.
- Use a flashlight to convey information using a pattern of on and off.
- Use Morse code to send information.
- Build an instrument with a box and rubber bands of varying sizes that can be plucked in a pattern to communicate information.
- Use musical patterns on a xylophone or tuning forks to convey information.
- Use string and cups to build a simple “phone” to send information.
- After small groups finish designing and building, they should put together a presentation that includes a written description/explanation of how patterns are used to communicate information. They can also include pictures, video or audio recordings, and/or models to support their explanation.
- Each group presents their design solution to the class. After observing each design solution, students should classify each based on the type or types of patterns used to communicate (e.g., sound, light, or both).
- Students investigate how well the solutions perform under a range of likely conditions (e.g., environmental noise or light, increases in distance). This may involve additional research, planning and conducting multiple investigations to produce data, and collecting and analyzing additional data that can be used as evidence to support conclusions. All tests that are planned and carried out should be fair tests in which variables are controlled and failure points are considered in order to identify elements of the design solution that do and do not meet criteria and constraints.
- Students compare the solutions, determining which can be used to successfully communicate information over a distance using patterns. Students should determine how well each design solution meets criteria, using data as evidence to support their thinking.

Throughout this process, communicating with peers is important, and can lead to better designs. After completing the engineering design process, students should discuss ways in which we use patterns in today's technology to communicate over long distances and how engineers have improved existing technologies over time in order to increase benefits, decrease known risks, and meet societal demands.

Integration of engineering-
Engineering design is an integral part of this unit of study. Students are expected to research a problem and communicate proposed solutions to others; define a simple design problem including specified criteria for success and constraints on materials time, or cost; and plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of the design solution that can be improved. This process is outlined in greater detail in the previous section.

Big Idea/Common Thread:

- Energy can travel in patterns of waves. Waves are regular patterns of motion.

Enduring Understanding:

- Waves are regular patterns of motion, which can be made in water by disturbing the surface.
- Waves of the same type can differ in amplitude and wavelength.
- Waves can make objects move.

Essential Questions:

- What are waves and how can we use them to gather and transmit information?

Assessments

Possible Ongoing Formative Assessments
• Wrap It Up! Questions • Various levels of questioning • Teacher Observation • Student Observation • Class Discussions/Partner Talk • Science Notebook activities • Performance Expectation Activities: Investigate; Think Like a Scientist; Think Like an Engineer, STEAM Projects • Teacher Rubrics for Performance Expectations Activities • Hands-on labs

Summative Assessments
• Energy Unit Assessment (Waves)
Alternative Assessments
• Modified Energy Unit Assessment (Less answer choices, highlighted vocabulary, etc.)

Standards (NJSLS) Addressed in this Unit

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. (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)

Crosscutting Concepts

- **Patterns**
  - Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)
  - Similarities and differences in patterns can be used to sort and classify designed products. (4- PS4-3)

Science and Engineering Practices

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

- **Constructing Explanations and Designing Solutions**
  - 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 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)

Connections to Nature of Science

- Science findings are based on recognizing patterns. (4- PS4-1)

Computer Science and Design Thinking

8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data
8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
8.2.5.ED.1: Explain the functions of a system and its subsystems
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.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have

Career Readiness, Life Literacies, and Key Skills

CAREER AWARENESS, EXPLORATION, PREPARATION, AND TRAINING
● 9.2.5.CAP.4 - Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

LIFE LITERACY AND KEY SKILLS
● 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 (e.g., W.4.7, 8.2.5.ED.6).
● 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.2 - Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
● 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).
● 9.4.5.DC.8 - Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).

PRACTICES
● CLKSP1 - Act as a responsible and contributing community member and employee.
● CLKSP4 - Demonstrate creativity and innovation.
● CLKSP5 - Utilize critical thinking to make sense of problems and persevere in solving them.

Interdisciplinary Connections:

English Language Arts

Reading - Informational
● RI.4.1 - Refer to details and examples in a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3)
● RI.4.9 - Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)

Speaking and Listening
● SL.4.5 - Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1)

Mathematics

Mathematical Practices

● MP.4 Model with mathematics. (4-PS4-1)

Geometry
● 4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1)

Social-Emotional Competencies

- **Self-Awareness**: ability to recognize one's emotions and know one's strengths and limitations
    - Connections:
        - Regular check-ins to share feelings (Oral, Thumbs Up, Thumbs Down, Emojis, etc.)
        - Reflecting on one's learning (Oral, Thumbs Up, Thumbs Down, Pictures, etc.)

- **Self-Management**: ability to regulate and control one's emotions and behaviors, particularly in stressful situations
    - Connections:
        - Take a brain break and dance to ROYGBIV GoNoodle Video
        - Playing soft music/deep breathing - Waves
        - Use of cool down spot in classroom

- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one's actions influence and are influenced by others
    - Connections:
        - Students helping each other during small group work
        - Write positive comments on student projects

- **Relationship Skills**: refers to one's ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
    - Connections:
        - Class discussions
        - Incentives for individual students and small groups

- **Responsible Decision-Making**: refers to the ability to use multiple pieces of information to make ethical and responsible decisions

- Connections:
  - Class rules and routines
  - Class discussions
  - Following directions

UNIT OBJECTIVES

Students will be able to …

- 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)

  [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.]

Disciplinary Ideas

- 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).

Crosscutting Concepts

- Recognize that Similarities and differences in patterns can be used to sort and classify natural phenomena.

Science and Engineering Practices

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle.

Concepts	Students can...
• 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	• Describe waves as a regular pattern of motion produced by a disturbance. • Explain the motion of water waves. • Describe the wave properties of amplitude and wavelength.

beach. ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).	● Develop a model of waves to describe patterns in terms of amplitude and wavelength. ● Use the model to describe how waves cause objects to move.

Students will be able to …

- 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.]

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. See Appendix A, 3-5 Engineering Design.

Disciplinary Ideas

- Understand that 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.
- Understand that different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Crosscutting Concepts

- Recognize that similarities and differences in patterns can be used to sort and classify designed products.

Science and Engineering Practices

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Concepts	Students can...
● 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. ● Different solutions need to be tested in	● Identify digitized information. ● Describe how information can be transmitted over long distances. ● Explain how cell phones use digitized information.

order to determine which of them best solves the problem, given the criteria and the constraints.	• Describe the advantages of digitized information. • Use a pattern to transfer information. • Generate and compare multiple solutions that use patterns to transfer information, in order to determine which of the solutions best solves the problem.

SUGGESTED ACTIVITIES

- *WAVES* Brainpop video that discuss all types of waves--from the kind that travel through the ocean to the kind that travel through outer space! You'll learn how water, sound, light and even earthquakes travel in waves, and also about the characteristics between them that we can measure and observe. You'll also find out how to determine how much energy each wave carries and how we use time and frequency to measure different types of waves, whether they're electromagnetic or mechanical. www.brainpop.com

- *WAVE COMBINATOR GAME* This game enables students to change wavelength, amplitude and offset on a wave combinator machine. Practices and challenges are included for students to try. https://www.brainpop.com/games/wavecombinator/#

- *MAKING WAVES: HOW DOES ENERGY MOVE THROUGH WATER?* 4-PS4-1 This Science and Children article includes background information for the teacher and three investigations to share with the students. First, students create waves using a jump rope, then water, and then they model the movement of molecules using marbles and book. Through these activities, students will develop an understanding of how energy moves through all types of waves, and they will model the process of energy transfer. The activities use simple materials, but are effective at demonstrating wave energy. The instructional guide suggests questions (with answers) that may be used to guide student learning. Making Waves: How does energy move through water?

- *BITE SIZE PHYSICS: ENERGY AND WAVES BITE* 4-PS4-1 The Bite Size Physics website uses humor and simple hands-on activities to teach physics principles. This lesson gives a background lesson on waves, followed by several simple experiments to teach transverse and longitudinal waves, frequency, wavelength, and amplitude. The activities use only a rope, a slinky and colored tape to teach the concept, so they would be easy for the classroom teacher to reproduce for his or her students. http://ngss.nsta.org/Resource.aspx?ResourceID=201

- *WHAT ARE WAVES?* 4-PS4-1 Students explore making waves using everyday objects to begin developing an understanding of how waves are made, that waves carry energy, and that there are different types of waves. Students investigate examples of transverse and longitudinal waves at stations and use their science notebooks to record observations and predict the type of wave they are creating.
  http://ngss.nsta.org/Resource.aspx?ResourceID=357

  SIMON SAYS BIG AMPLITUDE, SMALL WAVELENGTH! 4-PS4-1 Found deep within this multi-unit document are directions for playing the game Simon Says! with waves. This simple simulation allows the students an opportunity to move around and participate in a guided model of amplitude and wavelength. The students create kinesthetic models of "waves" of varying amplitudes and wavelengths by walking and jumping. Simon Says Big Amplitude, Small Wavelength!

  POP BOTTLE WAVES AND HAIR DRYER RIPPLES 4-PS4-1 This is the first lesson in a series of lessons on waves. It is an exploratory lesson where students observe, draw and think about how waves are shaped, how they move and what creates them. The teachers creates a model using plastic bottles with colored water inside. The students then make their own models using the materials and procedures set up by the teacher. Students observe and record the waves and how they change. Students also observe how a hair dryer creates ripples on water that the teacher models for them. Students then gather together to discuss their observations. The teacher creates a collaboration board as a means of recording their ideas/explanations around the speed of the waves and evidence to support these ideas from their observations and investigation. Pop Bottle Waves and Hair Dryer Ripples

  SPEAKING IN PHASES 4-PS4-3 Students model how NASA uses radios wave signals to encode, transmit and decode information using a metronome and musical instruments. Students are then challenged to design a faster way to send signals. Speaking in Phases

- *MAKE SOME WAVES* In this activity, students use their own creativity (and their bodies) to make longitudinal and transverse waves. Through the use of common items, they will investigate the difference between longitudinal and transverse waves. Make Some Waves - Activity - TeachEngineering

- *SURFS UP!* This lesson introduces the concepts of longitudinal and transverse waves. Students see several demonstrations of waves and characterize them by transverse and longitudinal behavior. *Surf's Up! - Lesson - TeachEngineering*

Unit Specific Vocabulary
wave - a wave transfers energy from one place or object to another **amplitude** - amplitude is the distance between the crest or trough and the middle point of waves **wavelength** - a wavelength is the distance from one crest to the next crest in a wave **digitize** - to digitize means to put information in digital code form **Global Positioning System (GPS)** - a Global Positioning System is a tool that uses satellites to locate positions **transmit** - to transmit means to send

Instructional Materials and Learning Activities

Core Instructional Materials:

- *National Geographic Exploring Science 4*
- *National Geographic My NG connect Exploring Science 4 Digital Resources*
- *National Geographic Exploring Science through Literacy*
- *Hand2Mind Exploring Science Hands on Kit*

Digital Resources:

- Access the Next Generation Science Standards by Topic - The NGSS Standards
- http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas
- Next Generation Science Standards - lesson ideas
- https://www.generationgenius.com/

Supplemental Materials:

- Discovery Education: Streaming Plus & Science Tech Book

Leveled Readers:

Level Reader	Below-Level	On-Level	Above-Level
At the Movies	710L	840L	970L

Suggested Modifications

These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.

NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students

Special Education Students
• Help students visualize vibrations by giving them a shallow box of marbles. Have them gently shake the box to show how the marbles can vibrate. Relate the marbles to air particles that are too small to see. • To help students understand how waves move, give pairs of students a jump rope or other long rope to experiment with. Have them stretch the rope on the floor between them. Have students take turns causing a disturbance by quickly lifting one end of the rope. Have students describe the motion that traveled down the rope. (The lifting up motion traveled down the rope.) • To help students think through the sequence of events that occur when a cell phone is used to transmit a message, provide them with a copy of the illustration on *Exploring Science* page 63. Have them write each sentence from item 1 in the Wrap It Up section next to the corresponding part of the visual. Then have them add the following labels wherever they apply: *sound waves, digital code, radio waves.* • Ask either/or questions to help students explain their thinking • Provide sentence frames and sentence stems to explain their understanding of waves • Extended time for assignment • Prompting • Reassurance • Time to formulate ideas • Use of visual clues when reading • Preferential seating • Repeated directions • Instructional Aides in the classroom setting • Peer models • Preview content vocabulary and schema • Use of FM system to improve attention and support auditory information • Behavior chart to increase focus and work completion • Sensory breaks • Chromebook extensions *(text-to-speech)* • Graphic organizers
Students at Risk
• Help students visualize vibrations by giving them a shallow box of marbles. Have them gently shake the box to show how the marbles can vibrate. Relate the marbles to air particles that are too small to see. • To help students understand how waves move, give pairs of students a jump rope or other long rope to experiment with. Have them stretch the rope on the floor between them. Have students take

turns causing a disturbance by quickly lifting one end of the rope. Have students describe the motion that traveled down the rope. (The lifting up motion traveled down the rope.)
- To help students think through the sequence of events that occur when a cell phone is used to transmit a message, provide them with a copy of the illustration on *Exploring Science* page 63. Have them write each sentence from item 1 in the Wrap It Up section next to the corresponding part of the visual. Then have them add the following labels wherever they apply: *sound waves, digital code, radio waves.*
- Ask either/or questions to help students explain their thinking
- Provide sentence frames and sentence stems to explain their understanding of waves
- Response to intervention - targeted skill/goal improvement plans within a set time frame
- Multisensory manipulatives
- Preferential seating
- Behavior chart to increase focus and work completion
- Use of FM system to improve attention and support auditory information
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Leveled texts
- Audio books
- Consultation with academic support teachers to address skills identified by the classroom teacher
- Modification of assignments and assessments
- Splitting up open ended components of assessments into manageable tasks

English Language Learners

- Help students visualize vibrations by giving them a shallow box of marbles. Have them gently shake the box to show how the marbles can vibrate. Relate the marbles to air particles that are too small to see.
- To help students understand how waves move, give pairs of students a jump rope or other long rope to experiment with. Have them stretch the rope on the floor between them. Have students take turns causing a disturbance by quickly lifting one end of the rope. Have students describe the motion that traveled down the rope. (The lifting up motion traveled down the rope.)
- To help students think through the sequence of events that occur when a cell phone is used to transmit a message, provide them with a copy of the illustration on *Exploring Science* page 63. Have them write each sentence from item 1 in the Wrap It Up section next to the corresponding part of the visual. Then have them add the following labels wherever they apply: *sound waves, digital code, radio waves.*
- Ask either/or questions to help students explain their thinking
- Provide sentence frames and sentence stems to explain their understanding of waves
- Collaborate with English Language teacher.
- Preview content vocabulary *(with pictures and labels in the student's first language)*
- Visual clues (pictures)
- Repeated directions
- Check for understanding
- Ask pointed questions
- Peer models

- English language supports for parents of non English speaking students
- Use of iPad for translation between English and the student's first language
- Materials presented at lower TC levels
- Audio books
- Use of interactive English vocabulary websites *(Learning Chocolate)*
- Small flip book of content specific vocabulary with translations and pictures

Gifted and Talented

- Give students a shallow box of marbles and have them gently shake the box to model vibrating air particles. Challenge students to model a sound wave moving through the marbles.
- Give pairs of students a spring toy and have them stretch it on the floor between them. Challenge students to find three different ways to send a wave to each other. (by moving it back and forth, side to side, or pinching coils together and letting go)
- Have students write the sequence of events that occur when a phone is used to access a GPS map.
- Challenge questions and higher level thinking while reading both fiction and nonfiction texts
- Higher TC level texts
- Advanced STEAM activities
- Assigned leadership roles within class

Students with 504 Plans

- Help students visualize vibrations by giving them a shallow box of marbles. Have them gently shake the box to show how the marbles can vibrate. Relate the marbles to air particles that are too small to see.
- To help students understand how waves move, give pairs of students a jump rope or other long rope to experiment with. Have them stretch the rope on the floor between them. Have students take turns causing a disturbance by quickly lifting one end of the rope. Have students describe the motion that traveled down the rope. (The lifting up motion traveled down the rope.)
- To help students think through the sequence of events that occur when a cell phone is used to transmit a message, provide them with a copy of the illustration on *Exploring Science* page 63. Have them write each sentence from item 1 in the Wrap It Up section next to the corresponding part of the visual. Then have them add the following labels wherever they apply: *sound waves, digital code, radio waves.*
- Extended time for assignment
- Prompting
- Reassurance
- Time to formulate ideas
- Use of visual clues when reading
- Preferential seating
- Repeated directions
- Instructional Aides in the classroom setting
- Peer models
- Preview content vocabulary and schema
- Use of FM system to improve attention and support auditory information

- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Graphic organizers

Grade 4 Science Curriculum

Unit 3: Life Science- Structure and Function

Unit Overview

Excerpt from NJ State model curriculum, Units 3 & 4, "What it looks like in the classroom"

In this unit of study, students spend time observing plants and animals in order to gather evidence that organisms are living systems. A system is made up of structures and processes that interact and enable the system to function. Every plant and animal can be described in terms of its internal and external structures and their interactions, and these structures each have specific functions that support survival, growth, behavior, and reproduction for the organism.

Using a variety of plants and animals as examples, students need multiple opportunities to:

- Describe the internal and external structures of a plant or animal and the function of each of those structures. Description should explain how each structure serves various functions in growth, survival, behavior, and/or reproduction*. (Note: This is limited to macroscopic structures within plant and animal systems, and could include such structures as thorns, stems, roots, and colored petals for plants, and heart, stomach, lung, brain, and skin for animals.)*
- Describe the interactions that occur among the structures within the plant or animal system.

As students observe the structures of an animal or plant, explain the function of each, and describe how these structures help the animal grow, survive, and/or reproduce, they should use evidence from their observations to support their explanations.

In this unit of study, students use the concept of *systems* to understand that every animal has internal and external structures that allow it to take in information from the environment in which it lives, process that information, and respond in ways that increase its chances to grow, reproduce, and survive.

The way in which an organism gathers information will depend on the organism and the body structures that pick up signals from the environment. Many animals, like humans, have sense organs that gather information from the environment through seeing, hearing, feeling, smelling, and tasting. Some animals have sensory receptors or other mechanisms that allow them to sense such things as light, temperature, moisture, and movement. Students need to understand that all animals pick up information from their environment through senses or sensory receptors. In many animals, nerves or neurons then transfer that information to a centralized place (the brain) where it is processed; then, through reflex reactions or learned behaviors, the organism responds in ways

that will help it survive and reproduce. In addition, animals often store this information in their brains as memories and use these memories to guide future actions. As students observe animals, either through direct observation or using text and digital resources, they should use models, such as drawings, diagrams, and pictures, to describe the ways that animals (and humans) receive, process, store, and respond to information from the environment in order to survive, grow, and reproduce.

To continue the progression of learning, fourth graders focus on the sense of sight, using models to understand and describe that light reflects from objects and enters the eye, allowing objects to be seen. In first grade, students learned that objects can be seen only when illuminated, and they determined the effect of placing different materials in the path of a beam of light. In this unit, students need opportunities to develop a conceptual understanding of the role that light plays in allowing us to see objects. Using a model can help with this process.

Big Idea/Common Thread:

- Plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- An object can be seen when light reflected from its surface enters the eye.

Enduring Understanding:

- Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction. (LS1.A)
- Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions. (LS1.D)
- Objects can be seen when light reflected from their surface enters our eyes. (PS4.B)

Essential Questions:

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

Assessments

Possible Ongoing Formative Assessments
• Wrap It Up! Questions • Various levels of questioning • Teacher Observation • Student Observation • Class Discussions/Partner Talk • Science Notebook activities • Performance Expectation Activities: Investigate; Think Like a Scientist; Think Like an Engineer, STEAM Projects • Teacher Rubrics for Performance Expectations Activities • Hands-on labs
Summative Assessments
• Life Science Unit Assessment
Alternative Assessments
• Modified Life Science Unit Assessment (Less answer choices, highlighted vocabulary, etc.)

Standards (NJSLS) Addressed in this Unit

Disciplinary Core Ideas
• **PS4.B: Electromagnetic Radiation** An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2) • **LS1.A: 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) • **LS1.D: Information Processing** Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)
Crosscutting Concepts
• **Cause and Effect** Cause and effect relationships are routinely identified. (4-PS4-2)

- **Systems and System Models**
  A system can be described in terms of its components and their interactions.
  (4- LS1-1), (LS1-2)

Science and 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 to describe phenomena. (4-PS4-2)
  - Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)

- **Engaging in Argument from Evidence**
  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. (4-LS1-1)

Computer Science and Design Thinking

8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data
8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
8.2.5.ED.1: Explain the functions of a system and its subsystems
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.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have

Career Readiness, Life Literacies, and Key Skills

CAREER AWARENESS, EXPLORATION, PREPARATION, AND TRAINING
● 9.2.5.CAP.4 - Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

LIFE LITERACY AND KEY SKILLS

● 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 (e.g., W.4.7, 8.2.5.ED.6).
● 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.2 - Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
● 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).
● 9.4.5.DC.8 - Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).

PRACTICES
● CLKSP1 - Act as a responsible and contributing community member and employee.
● CLKSP4 - Demonstrate creativity and innovation.
● CLKSP5 - Utilize critical thinking to make sense of problems and persevere in solving them.

Interdisciplinary Connections:

English Language Arts

<u>Reading - Informational</u>
● RI.4.1 - Refer to details and examples in a text and make and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
● RI.4.4 - Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.
● RI.4.7 - Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
● RI.4.9 - Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from two texts on the same topic in order to write or speak

about the subject knowledgeably.

Writing
● W.4.2 - Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
● 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.

Speaking and Listening
● 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.
● SL.4.4 - Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
● SL.4.5 - Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Mathematics
Mathematical Practices
● MP.4 - Model with mathematics. (4-PS4-2)

Geometry
● 4.G.A.1 - Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2)
● 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)

Social-Emotional Competencies

- **Self-Awareness**: ability to recognize one's emotions and know one's strengths and limitations
    - Connections:
        - Regular check-ins to share feelings (Oral, Thumbs Up, Thumbs Down, Emojis, etc.)
        - Reflecting on one's learning (Oral, Thumbs Up, Thumbs Down, Pictures, etc.)

- **Self-Management**: ability to regulate and control one's emotions and behaviors, particularly in stressful situations
    - Connections:
        - Dance a to a Backbone video GoNoodle Video
        - Sing-a-Long Bones video
        - Playing soft music - Sounds of Nature
        - Use of cool down spot in classroom

- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one's actions influence and are influenced by others
    - Connections:
        - Students helping each other during small group work, including planting/gardening project
        - Write positive comments on student projects

- **Relationship Skills**: refers to one's ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
    - Connections:
        - Class discussions
        - Incentives for individual students and small groups

- **Responsible Decision-Making**: refers to the ability to use multiple pieces of information to make ethical and responsible decisions
    - Connections:
        - Class rules and routines
        - Class discussions
        - Following directions

UNIT OBJECTIVES

Students will be able to …

- Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. (4-LS1-1)
    [Clarification Statement: Examples of structures- thorns,
    stems, roots, colored petals, heart, stomach, lung, brain, and skin]
    [Assessment Boundary: Assessment is limited to macroscopic structures

within plant and animal systems.]

Disciplinary Ideas

- Understand that plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Crosscutting Concepts

- Recognize that a system can be described in terms of its components and their interactions.

Science and Engineering Practices

- Construct an argument with evidence, data, and/or a model.

4-LS1-1

Concepts	Students can...
• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. • A system can be described in terms of its components and their interactions.	• Construct an argument to support the claim that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Examples of structures could include: Plants: thorns, stems, roots, colored petals Animals: heart, stomach, lungs, brain, skin • Describe an organism's system in terms of its components and their interactions. • Construct an argument with evidence, data, and/or a written explanation or visual model.

Students will be able to …

- Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)

  [Clarification Statement: Emphasis is on systems of information transfer]
  [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or how sensory receptors function.]

Disciplinary Ideas

- Understand that different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.

Animals are able to use their perceptions and memories to guide their actions.

Crosscutting Concepts

- Recognize that a system can be described in terms of its components and their interactions.

Science and Engineering Practices

- Use a model to test interactions concerning the functioning of a natural system.

4-LS1-2

Concepts	Students can...
• Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. • Animals are able to use their perceptions and memories to guide their actions. • A system can be described in terms of its components and its interactions.	• Develop a visual model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways • Describe an organism's sensory system in terms of its components and its interactions. • Use a visual model to represent interactions concerning the function of a sensory system. (environmental information, sense receptors, perception/memory, animal behavior)

Students will be able to …

- Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2)

  [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

Disciplinary Ideas

- Understand that an object can be seen when light reflected from its surface enters the eyes.

Crosscutting Concepts

- Recognize that cause and effect relationships are routinely identified.

Science and Engineering Practices

- Develop a model to describe phenomena.

4-PS4-2

Concepts	Students can...

• An object can be seen when light reflected from its surface enters the eyes. • Cause-and-effect relationships are routinely identified.	• Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen • Identify cause-and-effect relationships. • Develop a model to describe a sensory system such as sight.

SUGGESTED ACTIVITIES

Structure and Function

- Describe the internal and external structures of a plant or animal and the function of each of those structures. Description should explain how each structure serves various functions in growth, survival, behavior, and/or reproduction. *(Note: This is limited to macroscopic structures within plant and animal systems, and could include such structures as thorns, stems, roots, and colored petals for plants, and heart, stomach, lung, brain, and skin for animals.)*

- Describe the interactions that occur among the structures within the plant or animal system.

- Monster Plants: Given a set of criteria about climate and soil, students research carnivorous plants and create a model that will support their argument of how external parts help this plant survive in its environment. (https://betterlesson.com/lesson/617285/monster-plants)

  Create Your Own Insect: Students will learn about the body parts of insects. They will learn about the function of these parts and how they might help the insect survive in their habitat. The students will create their ultimate insect. Create Your Own Insect

  Animal Mouth Structures: In this lesson, students observe several animals' mouth structures and explore how these structures help the animal obtain, handle, and eat food. Animal Mouth Structures

Sensory Systems

- Are two eyes better than one? Experiment with how two eyes give you more depth perception, which is the ability to judge how near or far objects are. Senses Experiment: Are Two Eyes Better Than One? (for Kids) - Nemours KidsHealth

- It may be tough to identify objects based only on your sense of touch. Touch combined with sight, hearing, and smell is much more effective. It's even tougher to identify objects if you

don't have your full sense of touch, like if you have a sock or glove on your hand. Senses Experiment: Brain Box (for Kids) - Nemours KidsHealth

- Amazing Animal Senses Some animals have developed amazing adaptations to their environments. Many different types of energy exist in the environment, some of which humans cannot detect. Here are some examples of how some animals sense the outside world and the anatomical structures that allow them to do so. Neuroscience for Kids - Animal Senses

- Designer Ears: Make Better Ears! Students will explore why animals' ears look different from their own and will explore what life would be like if their ears were shaped differently. Designer Ears

- Several experiments on finding our blind spot and how we recognize shapes. Sense of Sight

- Experiment with catching a ball while covering your right or left eye. Does it make a difference which eye is closed?

- Who Turned Off the Lights - Students use lines, rays and diagrams to explain how light rays reflecting on an object help us see the object. (https://betterlesson.com/lesson/617379/who-turned-out-the-lights)

Information Processing

- To review prior learning, ask students to describe what happens to our ability to see objects in a room with no light, and what happens when different types of materials are placed in the path of a beam of light. (If necessary, demonstrate using flashlights and a variety of transparent, translucent, and opaque materials).

- Using penlights, a variety of lenses, mirrors, and pieces of cardboard, allow students to explore the behavior of light when it comes into contact with these objects. Have students draw and describe what they observe.

- Using a cardboard shoebox with a 1-cm. slit at one end, shine a flashlight into the box through the slit, and ask students to describe what they see. Place a clear plastic cup of water in the path of the light, and ask students to describe what they observe.

    - Students should first observe that light travels in a straight line. Lenses and water allow the light to pass through; however, the beam of light is refracted (bent). Mirrors do not allow the light to pass through, but do reflect light, sending the beam in a different direction. The cardboard does not allow any light to pass through, and the beam of light is no longer visible in the same way.

- Next have students observe a large object, such as a book. Ask them to describe what they see. Place a sheet of transparency film or clear plastic wrap in front of the book, and ask students to again describe what they see. Ask, “How are you able to see the book even though I have placed something in between you and the object?”
    - Take away the clear plastic wrap and place a sheet of dark construction paper in front of the book, and ask student to describe what they see. Ask, “Why are you no longer able to see the book?”

- To help students as they try to understand the role that light plays in allowing us to see objects, tell them that they will be using a model that demonstrates how we see objects.

- Have students use pinhole viewers. (If possible, make these ahead of time. You can find a variety of models and types that are easy to build on the Internet. YouTube has a number of videos that show pinhole viewers made from a variety of materials such as a Pringles tube or black poster board.) Directions/Activity: https://services.math.duke.edu/~plesser/outreach/kenan/Activity%203%20Pinhole%20Viewers.pdf
    - Show students how the pinhole viewers are constructed and what is inside each. Then have students go outside and view objects using the pinhole viewers. As students make observations, they should document what they observed.
    - As a class, discuss what students observed, then draw a model on the board that depicts the phenomenon. (Light bounces off of an object, travels through the pinhole, and is visible—upside down—on the tracing paper inside the pinhole viewer.)
    - Tell students that this is what happens with our eyes. Light bounces off objects, similar to the way in which it bounces off a mirror, and that light travels into the eye, enabling us to see the objects. We could see the book through the clear plastic wrap because the light that bounces off the object is able to travel through the transparent material and still reach our eyes. We could not see the book through the dark construction paper because the light that was bouncing off the object could not travel

through the paper, so our eyes did not receive that light. Therefore, we did not see the book.
    - With guidance, as needed, have students draw models/diagrams of the pinhole viewer and the human eye, and have them describe what they observed.

Unit Specific Vocabulary
external- parts of an organism that are visible **function-** the kind of action or activity specific to a thing **internal-** parts of an organism found within an organism **organism-** a unit of life, an individual plant or animal or single cell structure **reproduction**- how an organism produces offspring **sensory system**- how an organism makes sense of their environment **structure-** anything composed of parts, arranged together, parts of an organism **survival-** the process by which an organism exists

Instructional Materials and Learning Activities
Core Instructional Materials: ● *National Geographic Exploring Science 4* ● *National Geographic My NG connect Exploring Science 4 Digital Resources* ● *National Geographic Exploring Science through Literacy* ● *Hand2Mind Exploring Science Hands on Kit* *Digital Resources*: ● PhET - online simulations ● STEM Resource Finder - online simulations (requires Java) ● http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas ● http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas ● https://www.generationgenius.com/ *Supplemental Materials*: ● Discovery Education: Streaming Plus & Science Tech Book

Leveled Readers:

Level Reader	Below-Level	On-Level	Above-Level
Weird But True!	690L	810L	920L
The Chesapeake Bay	720L	920L	910L

Suggested Modifications

These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.

NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students

Special Education Students
● Help students create study cards (or write/draw in science notebook) with the six plant structures on one side and three descriptive words or complete-sentence descriptions on the other side. ● Have students create study cards (or write/draw in science notebook) with the name of an organ on one side and key words that describe the organ's function on the other side. ● Give students a photocopy of *Exploring Science* pages 82–83 with blank labels and descriptions. Write a word bank on the board and help students label the bones of the elephant. ● Ask either/or questions to help students explain their thinking ● Provide sentence frames and sentence stems to explain their understanding of the structure and function of organisms ● Extended time for assignment ● Prompting ● Reassurance ● Time to formulate ideas ● Use of visual clues when reading ● Preferential seating ● Repeated directions ● Instructional Aides in the classroom setting ● Peer models ● Preview content vocabulary and schema ● Use of FM system to improve attention and support auditory information ● Behavior chart to increase focus and work completion ● Sensory breaks ● Chromebook extensions *(text-to-speech)* ● Graphic organizers ●
Students at Risk
● Help students create study cards (or write/draw in science notebook) with the six plant structures on one side and complete-sentence descriptions on the other side. ● Have students create study cards (or write/draw in science notebook) with the name of an organ on one side and key words that describe the organ's function on the other side. ● Give students a photocopy of *Exploring Science* pages 82–83 with blank labels and descriptions. Write a word bank on the board and help students label the bones of the elephant. ● Ask either/or questions to help students explain their thinking ● Provide sentence frames and sentence stems to explain their understanding of the structure and

function of organisms
- Response to intervention - targeted skill/goal improvement plans within a set time frame
- Multisensory manipulatives
- Preferential seating
- Behavior chart to increase focus and work completion
- Use of FM system to improve attention and support auditory information
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Leveled texts
- Audio books
- Consultation with academic support teachers to address skills identified by the classroom teacher
- Modification of assignments and assessments
- Splitting up open ended components of assessments into manageable tasks

English Language Learners

- Help students create study cards (or write/draw in science notebook) with the words *flower, petal, leaf, stem, thorn,* and r*oot* on one side and a picture of the named structure on the other side.
- Help students create study cards (or write/draw in science notebook) with the six plant structures on one side and two or three descriptive words on the other side.
- Help students create study cards (or write/draw in science notebook) with the six plant structures on one side and complete-sentence descriptions on the other side.
- Have students create study cards (or write/draw in science notebook) with the name of an organ on one side and key words that describe the organ's function on the other side.
- Give students a photocopy of *Exploring Science* pages 82–83 with blank labels and descriptions. Write a word bank on the board and help students label the bones of the elephant.
- Ask either/or questions to help students explain their thinkinG
- Provide sentence frames and sentence stems to explain their understanding of the structure and function of organisms
- Collaborate with English Language teacher. Preview content vocabulary *(with pictures and labels in the student's first language)*
- Visual clues (pictures)
- Repeated directions
- Check for understanding
- Ask pointed questions
- Peer models
- English language supports for parents of non English speaking students
- Use of iPad for translation between English and the student's first language
- Materials presented at lower TC levels
- Audio books
- Use of interactive English vocabulary websites *(Learning Chocolate)*
- Small flip book of content specific vocabulary with translations and pictures

Gifted and Talented

- In their science notebooks or on index cards, have students write the name of an organ, a detailed

description of the function, the name of the organ system the organ is part of, and an interesting fact about that organ in an elephant.
- Give students a photocopy of the skeleton of a dog. Have them compare and contrast the dog skeleton with the elephant skeleton pictured on *Exploring Science* pages 82–83. Have them discuss reasons for any differences they observe.
- Challenge questions and higher level thinking while reading both fiction and nonfiction texts
- Higher TC level texts
- Advanced STEAM activities
- Assigned leadership roles within class

Students with 504 Plans

- Help students create study cards with the six plant structures on one side and complete-sentence descriptions on the other side.
- Have students create study cards (or write/draw in science notebook) with the name of an organ on one side and key words that describe the organ's function on the other side.
- Give students a photocopy of *Exploring Science* pages 82–83 with blank labels and descriptions. Write a word bank on the board and help students label the bones of the elephant.
- Ask either/or questions to help students explain their thinking
- Provide sentence frames and sentence stems to explain their understanding of the structure and function of organisms
- Extended time for assignment
- Prompting
- Reassurance
- Time to formulate ideas
- Use of visual clues when reading
- Preferential seating
- Repeated directions
- Instructional Aides in the classroom setting
- Peer models
- Preview content vocabulary and schema
- Use of FM system to improve attention and support auditory information
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Graphic organizers

Grade 4 Science Curriculum

Unit 4: Earth & Space Science- Earth's Systems: Processes that Shape the Earth

Unit Overview

Excerpt from NJ State model curriculum, Units 1 & 2- "What it looks like in the classroom"

In this unit of study, students are expected to develop understanding of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. As students plan and carry out investigations using models and observe the effects of earth processes in the natural environment, they learn to identify patterns of change; recognize cause-and-effect relationships among the forces that cause change in rocks, soil, and landforms; and construct explanations of changes that occur over time to earth materials.

In the first portion of the unit, fourth graders develop an understanding of cause-and-effect relationships when studying physical weathering and the rate of erosion by water, wind, ice, or vegetation. Students learn that rainfall helps to shape the land and affects the types of living things found in a region, and that living things affect the physical characteristics of a region. Students should make observations of their local environment to observe the types of living things that are common in the region, and they should look for evidence that water, ice, wind, organisms, and gravity have broken down rocks, soils, and sediments into smaller pieces and have moved them from one place to another.

In the classroom, students may use models that demonstrate how wind, water, and ice cause change to the surface of the earth. Students may use stream tables, soil, sand, and water to simulate the effects of moving water (rain, rivers) on rocks and soil. Following these types of experiences, students need opportunities to ask questions that will lead to further investigations. They can change a variable—such as the type of earth material (sand, soil, clay, silt), the angle of a hill's slope, the volume of water flow, the speed of water flow, and the relative rate of deposition—then collect and analyze data in order to determine the effects.

In addition to using models or time-lapse videos to understand the effects of water and ice on land, students may build and use models to simulate the effects of wind on earth materials. There are a variety of models that can be easily built. Students should have opportunities to change variables, such as the speed or volume of airflow. From these experiences, students should begin to understand that wind, water, and ice cause changes to the earth's surface, and that the stronger or faster the flow of wind or water, the greater the change it causes.

In this unit, students also need opportunities to observe ways in which plants affect the weathering and erosion of earth materials. Plants can have a variety of effects on rocks, soils, and landforms. Plants often slow or stop the effects of moving wind and water on land. Students can observe this phenomenon using models. As they make observations, students can change variables, such as the amount or type of plant used to slow or stop erosion, and they can collect and analyze data to determine cause-and-effect relationships between the amount of change and the plants used to prevent it. Then students can walk around the schoolyard and nearby neighborhoods to look for examples of plants that are used to prevent erosion.

In addition to slowing or preventing erosion, plants can cause weathering of rocks. Students can easily find examples in their own environment of growing plant and tree roots causing rocks, sidewalks, and driveways to crack and break down into smaller and smaller components. This phenomenon can also be simulated with models in the classroom. Students can soak lima beans in water overnight, then “plant” them in small cups containing a 2–3 cm. layer of wet Plaster of Paris on top of potting soil. (One or two seeds should be placed in the wet layer of plaster.) After a few days, the seeds will germinate and grow, eventually causing the dried plaster to crack. Again, students need opportunities to change variables, such as the number of seeds planted (one seed vs. multiple seeds, for example) and the type of seeds, then make observations and collect data to determine the amount of weathering each change causes to the dried plaster.

In the second portion of this unit, students learn that patterns can be used as evidence to explain changes to the earth’s landforms and rock formations, and that local, regional, and global patterns of rock formations reveal changes over time due to earth forces. If possible, students should make observations of local landforms; however, pictures from books and online sources can give students the opportunity to identify evidence of change from patterns in rock formations and fossils in rock layers. Students can support explanations for changes in a landscape over time in multiple ways, including the following:

- Pictures of a variety of landforms, such as sand dunes and canyons, can be used to show change due to weathering and erosion that have occurred over time.
- Pictures or diagrams of rock layers with marine shell fossils above rock layers with plant fossils and no shells can be used to indicate a change from land to water over long periods of time.
- Pictures of a canyon with different rock layers in the walls and a river at the bottom can be used to show that over time a river cut through the rock to form the canyon.

As students collect evidence, either from firsthand observations or from media resources, they should attempt to explain the changes that have occurred over time in each of the landscapes observed.

In this unit of study, students analyze and interpret data from maps to describe patterns of Earth's features. Students can use topographic maps of Earth's land and ocean floor in order to locate features such as mountains, mountain ranges, deep ocean trenches, and other ocean floor structures. As students analyze and interpret these types of maps, they begin to notice patterns in the types of structures and where these structures are found. Students learn that major mountain chains often form along or near the edge of continents. Once students locate continental boundaries, a further analysis of data can show students that there is a noticeable pattern of earth events, including volcanoes and earthquakes, which occur along these boundaries.

During this unit, students also learn that engineers develop or improve technologies to solve societal problems. A variety of hazards result from natural processes (e.g. earthquakes, floods, tsunamis, volcanic eruptions). Although we cannot eliminate the hazards, we can take steps to reduce their impacts. Students must have the opportunity to engage in the engineering design process in order to generate and compare multiple solutions that reduce the impacts of natural Earth processes on humans. This process should include the following steps:

- Students brainstorm possible problems that Earth processes can cause for humans. (Earth processes should be limited to earthquakes, volcanic eruptions, tsunamis, and floods.)
- Either as a class or in small groups, have students select one problem (such as the effects of volcanic eruptions on humans) to research.
- Small groups conduct research to determine possible solutions (such as consistent monitoring of volcanic activity and the use of early warning systems) that reduce the impacts of the chosen Earth process on humans.
- As a class, determine criteria and possible constraints on the design solutions. Criteria might include: saving lives and/or reducing property loss.
- Small groups investigate how well the solutions perform under a range of likely conditions. This may involve additional research and analysis of available data or planning and conducting investigations to produce data that will serve as the basis for evidence. During this process, students should plan and carry out fair tests in which variables are controlled and failure points are considered in order to identify elements of the design solution that do and do not meet criteria.
- Students compare the solutions based on how well they meet criteria and constraints, using data as evidence to support their thinking. At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. Students should routinely identify and test cause-and-effect relationships and use these relationships to explain the changes that they observe as they test design solutions.

At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. Students should routinely identify and test

cause-and-effect relationships and use these relationships to explain the changes that they observe as they test design solutions.

Engineering design performance expectations are an integral part of this unit of study. Students are expected to research a problem, generate and compare possible design solutions, and test the design solutions to determine how well each performs under a range of likely conditions. Using data as evidence, students identify elements of each design that need improvement and determine which design solution best solves the problem, given the criteria and the constraints. This process is outlined in greater detail in the previous section.

With the 2020 updates of the NJSLS for Science to include climate change, in addition to the previous excerpt from the NJ Model Curriculum, students will also learn about climate change, its effects on humans, and how to address those effects.

Big Idea/Common Thread:

- The Earth is affected by weathering and the rate of erosion, caused by water, ice, wind, or vegetation, and by natural and human-caused climate change. Humans have the ability to generate solutions to reduce these impacts on the planet.

Enduring Understanding:

- Certain features on Earth can be used to order events that have occurred in a landscape.
- Water and rainfall, ice, wind, or vegetation break rocks, soils, and sediments into smaller pieces and move them around.
- Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.
- A variety of hazards result from natural processes including climate change; humans cannot eliminate hazards, but can reduce their impacts.

Essential Questions:

- How can water, ice, wind and vegetation change the land over time?
- What patterns of Earth's features can be determined with the use of maps?
- How can we engineer ways to protect humans from Earth's natural hazards and human-caused climate change ?

Assessments

Possible Ongoing Formative Assessments

- Wrap It Up! Questions
- Various levels of questioning
- Teacher Observation
- Student Observation
- Class Discussions/Partner Talk
- Science Notebook activities
- Performance Expectation Activities: Investigate; Think Like a Scientist; Think Like an Engineer, STEAM Projects
- Teacher Rubrics for Performance Expectations Activities
- Hands-on labs

Summative Assessments

- Earth & Space Science Unit Assessment

Alternative Assessments

- Modified Earth & Space Science Unit Assessment (Less answer choices, highlighted vocabulary, etc.)

Standards (NJSLS) Addressed in this Unit

Disciplinary Core Ideas

- **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.B: Plate Tectonics and Large-Scale System Interactions**
  The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

- **ESS2.E: Biogeology**
  Living things affect the physical characteristics of their regions. (4- ESS2-1)

- **ESS3.B: Natural Hazards**
  A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)

- **ETS1.B: Designing Solutions to Engineering Problems**
  Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)

Crosscutting Concepts

- **Patterns**
  Patterns can be used as evidence to support an explanation. (4-ESS1-1),(4- ESS2-2)

- **Cause and Effect**
  Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1),(4-ESS3-2)

Science and Engineering Practices

- **Planning and Carrying Out Investigations**
  Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
  - 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**
  Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
  - Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

- **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.
  - Identify the evidence that supports particular points in an explanation. (4-ESS1-1)
  - Generate and compare multiple solutions to a problem based on how well they

meet the criteria and constraints of the design solution. (4-ESS3-2)

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 to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

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)

Computer Science and Design Thinking

8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data
8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
8.2.5.ED.1: Explain the functions of a system and its subsystems
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.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have

Career Readiness, Life Literacies, and Key Skills

CAREER AWARENESS, EXPLORATION, PREPARATION, AND TRAINING

● 9.2.5.CAP.4 - Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

LIFE LITERACY AND KEY SKILLS

● 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 (e.g., W.4.7, 8.2.5.ED.6).
● 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.2 - Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
● 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).
● 9.4.5.DC.8 - Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).

PRACTICES
● CLKSP1 - Act as a responsible and contributing community member and employee.
● CLKSP4 - Demonstrate creativity and innovation.
● CLKSP5 - Utilize critical thinking to make sense of problems and persevere in solving them.

Interdisciplinary Connections:

English Language Arts

Reading - Informational
● RI.4.1 - Refer to details and examples in a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2) ● RI.4.4 - Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.
● RI.4.7 - Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, 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)
● RI.4.9 - Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)

Writing
● W.4.7 - Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1),(4-ESS2-1)
● 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-ESS1-1),(4-ESS2-1)
● W.4.9 - Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)

Speaking and Listening
● 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.
● SL.4.4 - Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Mathematics

Mathematical Practices
● MP.2 - Reason abstractly and quantitatively. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)
● MP.4 - Model with mathematics. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)
● MP.5 - Use appropriate tools strategically. (4-ESS2-1)

Measurement and Data
● 4.MD.A.1 - Know relative sizes of measurement units within one system of units including km, m, cm, mm; 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. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1,12), (2,24), (3,36)...(4-ESS1-1),(4-ESS2-1)
● 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-ESS2-1),(4-ESS2-2)

Operations and Algebraic Thinking
● 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)

Social-Emotional Competencies

- **Self-Awareness**: ability to recognize one's emotions and know one's strengths and limitations
    - Connections:

        - Regular check-ins to share feelings (Oral, Thumbs Up, Thumbs Down, Emojis, etc.)
        - Reflecting on one's learning (Oral, Thumbs Up, Thumbs Down, Pictures, etc.)

- **Self-Management**: ability to regulate and control one's emotions and behaviors, particularly in stressful situations
    - Connections:
        - Dance a to a Backbone video GoNoodle Video
        - Sing-a-Long Bones video
        - Playing soft music - Sounds of Nature
        - Use of cool down spot in classroom

- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one's actions influence and are influenced by others
    - Connections:
        - Students helping each other during small group work, including planting/gardening project
        - Write positive comments on student projects

- **Relationship Skills**: refers to one's ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
    - Connections:
        - Class discussions
        - Incentives for individual students and small groups

- **Responsible Decision-Making**: refers to the ability to use multiple pieces of information to make ethical and responsible decisions
    - Connections:
        - Class rules and routines
        - Class discussions
        - Following directions

UNIT OBJECTIVES

Students will be able to …

- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (4-ESS1-1)
  [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.]

Disciplinary Ideas

- Understand that local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.
- Understand that the presence and location of certain fossil types indicate the order in which rock layers were formed.

Crosscutting Concepts

- Recognize that patterns can be used as evidence to support an explanation.

Science and Engineering Practices

- Identify the evidence that supports particular points in an explanation.

4-ESS1-1

Concepts	Students can...

• Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes and climate change.
• The presence and location of certain fossil types indicate the order in which rock layers were formed.
• Science assumes consistent patterns in natural systems.
• Patterns can be used as evidence to support 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, such as climate change.
	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.
	  • 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. • Support explanations using patterns as evidence (verbal or written explanations) • Identify evidence by using knowledge of rock layers, that supports an explanation of changes in landscape over time. (see examples above)

Students will be able to …

- Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (4-ESS2-1)

  [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.]

Disciplinary Ideas

- Understand that rainfall helps to shape the land and affects the types of living things found in a region.
- Understand that water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
- Understand that living things affect the physical characteristics of their regions.

Crosscutting Concepts

- Recognize that cause and effect relationships are routinely identified, tested, and used to explain change.

Science and Engineering Practices

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

4-ESS2-1

Concepts	Students can...

• 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.
• Cause-and-effect relationships are routinely identified, tested, and used to explain change.
	• Make observations and/or measurements to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation or climate change.
	
	Examples of variables to test could include (select one focus):
	
	  • Angle of slope in the downhill movement of water
	  • Amount of vegetation
	  • Speed of the wind
	  • Relative rate of deposition
	  • Cycles of freezing and thawing of water
	  • Cycles of heating and cooling
	  • Volume of water flow
	• Identify, test, and use cause-and-effect relationships in order to explain change.
	• Make observations and/or measurements to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, climate change, or vegetation.

Students will be able to …

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

Disciplinary Ideas

- Understand that the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges.
- Recognize that maps can help locate the different land and water features areas of Earth.

Crosscutting Concepts

- Recognize that patterns can be used as evidence to support an explanation.

Science and Engineering Practices

- Analyze and interpret data to make sense of phenomena using logical reasoning.

4-ESS2-2

Concepts	Students can...

• Maps can help locate the different land and water features of Earth.
• The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns.
• Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans.
• Major mountain chains form inside continents or near their edges.
• Patterns can be used as evidence to support an explanation.
	• Analyze and interpret data from maps to describe patterns of Earth's features.
	Maps can include:
	  • Topographic maps of Earth's land
	  • Topographic maps of Earth's ocean floor
	  • Locations of mountains
	  • Locations of continental boundaries
	• Locations of volcanoes and earthquakes
	• Support an explanation using patterns as evidence.
	• Analyze and interpret data to make sense of phenomena using logical reasoning.

Students will be able to …

- Generate and compare multiple solutions to reduce the impacts of natural Earth processes **and climate change have**** on humans.* (4-ESS3-2)

  [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.]

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.See Appendix A, 3-5 Engineering Design.

**Updated with 2020 NJSLS language

Disciplinary Ideas

- Understand that a variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions).

- Recognize that humans cannot eliminate the hazards but can take steps to reduce their impacts.
- Understand that testing a solution involves investigating how well it performs under a range of likely conditions.

Crosscutting Concepts

- Recognize that cause and effect relationships are routinely identified, tested, and used to explain change.

Science and Engineering Practices

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

4-ESS3-2

Concepts	Students can...

• A variety of hazards result from natural processes (e.g., earthquakes, floods, tsunamis, volcanic eruptions, climate change).
• Humans cannot eliminate the hazards, but they can take steps to reduce their impacts.
• Testing a solution involves investigating how well it performs under a range of likely conditions.
• Cause-and-effect relationships are routinely identified, tested, and used to explain change.
• Engineers improve existing technologies or develop new ones to increase benefits, decrease known risks, and meet societal demands.
	• Generate and compare multiple solutions to reduce the impacts of natural Earth processes and climate change have on humans
	Examples of solutions could include:
	  • Designing an earthquake-resistant building.
	  • Improving monitoring of volcanic activity.
	  • Developing ways to limit erosion due to weather.
	• Identify and test cause-and-effect relationships in order to explain change.
	• Research and communicate with peers about designing different solutions to a problem.
	• Present a design solution.

SUGGESTED ACTIVITIES

- Bill Nye Video-Erosion: Bill Nye, "The Science Guy", presents a video describing the effects of weathering (wind, water, ice) on landforms. Bryce Canyon is used as an example of the

ways in which freezing water, plant roots, and wind weather the earth's surface creating the means for erosion. Students in video simulate effects of weathering which can be duplicated in a classroom setting. Nye also emphasizes the passage of time in millions of years as he explains the slower erosive effects of certain types of weathering. https://www.schooltube.com/video/9522ccca25154ea897ff/Bill%20Nye%20erosion

- Gary's Sand Journal: This book allows students to observe illustrations of magnified sand particles with guided dialogue from an earth scientist who discusses sand origins. This book can be used to introduce students to types of sand, explain how earth processes were responsible for their creation, and discuss the work of earth scientists. After reading this book, students may use it as a resource when examining their own sand samples. They could list properties, discuss sand origins, and illustrate samples in a science journal. http://www.scienceandliteracy.org/units/books/garys-sand-journal

- Slideshow on weathering, erosion and deposition. Ties weathering, erosion and deposition together as one continuing process. http://www.slideshare.net/MMoiraWhitehouse/weathering-erosion-and-depositioneasier

- An educational resource page to find lesson plans and teaching tips about dirt, rocks, rain, sand, wind, soil, and freeze-thaw. https://educators.brainpop.com

- Kids Discover Activity on Erosion demonstrating the power of rain. http://www.kidsdiscover.com/teacherresources/erosion-ever-changing-earth/

- The Science Penguin - Seven Ideas to Teach Slow Changes: Weathering, Erosion, and Deposition http://thesciencepenguin.com/2016/02/erosion.html

- Engineering for the Three Little Pigs - Students build three different sand castles and test them for strength and resistance to weathering. https://www.teachengineering.org/activities/view/cub_earth_lesson1_activity1
- NEED.org Understanding Climate Change activity guide - A comprehensive guide for learning about climate change through hands-on critical thinking activities from an energy non-profit.

Unit Specific Vocabulary
boundary- a dividing line

Climate change - a significant change in the measures of climate (like temperature, precipitation, wind patterns, among other effects) lasting for an extended period of time.
deposition- occurs when eroded sediments are dropped in another location, ending the process of erosion
rate of deposition- the speed at which deposition occurs
earthquake- a sudden shaking of the ground caused by the movement of rock Underground
erosion- the process by which wind, water, ice, gravity, or other natural forces move sediment over Earth's surface
flood- an overflowing of a large amount of water beyond its normal confines
fossil- a trace of a plant or animal that lived long ago
glacier- a large mass of ice resting on, or overlapping a land surface
hazard- a danger or risk
landforms- a large natural structure on the earth's surface such as a mountain, a plain, or a valley
landscape- all the visible features of an area of countryside or land
minerals- natural, nonliving solid crystal that makes up rocks
plate tectonics- the individual plates that Earth's crust is made up of. These plates move gradually in relation to each other and much of the Earth's seismic activity occurs at the boundaries or edges of these plates.
sediment- any eroded material (weathered rock, sand, and/or soil) that is carried from one place to another by a medium such as wind or water.
topographic maps- provides detailed graphic representation of relatively small areas on the ground.
tsunami- a damaging type of fast-moving water wave that forms when a sudden force, such as an undersea earthquake or landslide, shifts massive amounts of water.
vegetation- plant life that grows in a certain area
volcanic eruption- when magma and gases that have been blocked in chambers under the Earth's surface burst through the top of a volcano
weathering- the natural breakdown of rocks into smaller fragments. Water, wind, and living things can all cause weathering.

***Definitions may be altered based on resource used**

Instructional Materials and Learning Activities

Core Instructional Materials:

- *National Geographic Exploring Science 4*
- *National Geographic My NG connect Exploring Science 4 Digital Resources*
- *National Geographic Exploring Science through Literacy*
- *Hand2Mind Exploring Science Hands on Kit*

Digital Resources:

- Access the Next Generation Science Standards by Topic - The NGSS Standards
- http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas
- http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas
- 3D design programs such as TinkerCAD (www.tinkercad.com)
- NASA Climate kids
- AMNH Ology What is Climate Change
- Lamont Doherty Earth Observatory Climate Kids Corner
- SUNY Fredonia Climate Lesson Plans & Classroom Activities
- https://www.generationgenius.com/

Supplemental Materials:

- Discovery Education: Streaming Plus & Science Tech Book

Leveled Readers:

Level Reader	Below-Level	On-Level	Above-Level
Exploring the Coral Reefs	690L	820L	910L
The Good Earth	730L	820L	920L
What is Climate Change by Gail Herman		830L	

Suggested Modifications

These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.

NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students

Special Education Students
● Ask yes/no questions, such as: Is the Pacific Northwest dry? (No.) Is it very cold? (No.) Do evergreens live there? (Yes.) Do birds live there? (Yes.) ● Provide students with sentence frames, such as: *The weather in the Pacific Northwest can be described as (rainy) and (mild). Some plants that live there include (evergreens) and (wildflowers). Some animals that live there include (snails) and (birds).* ● Have students complete sentence stems, such as: *The weather in the Pacific Northwest can be described as . . . Some of the plants that live there include . . . Some of the animals in this region include . .* ● Connect concepts to real life: *Ask: What happens when a drop of water lands on a paper towel? (It is absorbed.) What happens when a drop of water lands on a piece of plastic wrap? (It does not go through the wrap.) Which material is more like the skin of a reptile or stem of a cactus? Explain. (The plastic wrap is more like the outer coverings of these living things because it prevents water from moving through it.)* ● Help students explain how erosion and deposition shape and change the land: *Help students compare and contrast these processes by asking either/ or questions, such as: Which process moves sediment from place to place—erosion or deposition? (erosion) Which process drops sediment in a new place—erosion or deposition? (deposition)* ● Help students compare and contrast these processes by providing sentence frames, such as: *The movement of sediment from place to place is called (erosion). The dropping of sediment in a new place is called (deposition).* ● Help students compare and contrast these processes by providing sentence stems, such as: *Erosion is . . . Deposition is . . . Things that cause erosion and deposition include . . .* ● Have students complete sentence stems, such as: *Natural hazards cannot . . . but their impacts . . . Cables on bridges in earthquake-prone areas help prevent damage by . . . Links on bridges in earthquake-prone areas help prevent damage by . .* ● Extended time for assignment ● Prompting ● Reassurance ● Time to formulate ideas ● Use of visual clues when reading ● Preferential seating ● Repeated directions ● Instructional Aides in the classroom setting ● Peer models ● Preview content vocabulary and schema ● Use of FM system to improve attention and support auditory information

- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Graphic organizers

Students at Risk

- Have students complete sentence stems, such as: *The weather in the Pacific Northwest can be described as . . . Some of the plants that live there include . . . Some of the animals in this region include . .*
- Connect concepts to real life: *Ask: What happens when a drop of water lands on a paper towel? (It is absorbed.) What happens when a drop of water lands on a piece of plastic wrap? (It does not go through the wrap.) Which material is more like the skin of a reptile or stem of a cactus? Explain. (The plastic wrap is more like the outer coverings of these living things because it prevents water from moving through it.)*
- Help students explain how erosion and deposition shape and change the land: *Help students compare and contrast these processes by providing sentence stems, such as: Erosion is . . . Deposition is . . . Things that cause erosion and deposition include...*
- Have students complete sentence stems, such as: *Natural hazards cannot . . . but their impacts . . . Cables on bridges in earthquake-prone areas help prevent damage by . . . Links on bridges in earthquake-prone areas help prevent damage by . .*
- Ask either/or questions to help students explain their thinking
- Provide sentence frames and sentence stems to explain their understanding of processes that shape the Earth
- Response to intervention - targeted skill/goal improvement plans within a set time frame
- Multisensory manipulatives
- Preferential seating
- Behavior chart to increase focus and work completion
- Use of FM system to improve attention and support auditory information
- Sensory breaks
- Chromebook extensions *(text-to-speech)*
- Leveled texts
- Audio books
- Consultation with academic support teachers to address skills identified by the classroom teacher
- Modification of assignments and assessments
- Splitting up open ended components of assessments into manageable tasks

English Language Learners

- Ask yes/no questions, such as: Is the Pacific Northwest dry? (No.) Is it very cold? (No.) Do evergreens live there? (Yes.) Do birds live there? (Yes.)
- Provide students with sentence frames, such as: *The weather in the Pacific Northwest can be described as (rainy) and (mild). Some plants that live there include (evergreens) and (wildflowers). Some animals that live there include (snails) and (birds).*
- Have students complete sentence stems, such as: *The weather in the Pacific Northwest can be described as . . . Some of the plants that live there include . . . Some of the animals in this region*

include . .

- Help students explain how erosion and deposition shape and change the land: *Help students compare and contrast these processes by asking either/ or questions, such as: Which process moves sediment from place to place—erosion or deposition? (erosion) Which process drops sediment in a new place—erosion or deposition? (deposition)*
- Help students compare and contrast these processes by providing sentence frames, such as: *The movement of sediment from place to place is called (erosion). The dropping of sediment in a new place is called (deposition).*
- Help students compare and contrast these processes by providing sentence stems, such as: *Erosion is . . . Deposition is . . . Things that cause erosion and deposition include . . .*
- Provide sentence frames, such as: *When glaciers scrape large amounts of rock from an area of land, a (U-shaped) valley forms. As glaciers move over a rock, they scrape the rock (smooth)*
- Have students complete sentence stems, such as: *Natural hazards cannot . . . but their impacts . . . Cables on bridges in earthquake-prone areas help prevent damage by . . . Links on bridges in earthquake-prone areas help prevent damage by . .*
- Collaborate with English Language teacher
- Preview content vocabulary *(with pictures and labels in the student's first language)*
- Collaborate with English Language teacher.
- Visual clues (pictures)
- Repeated directions
- Check for understanding
- Ask pointed questions
- Peer models
- English language supports for parents of non English speaking students
- Use of iPad for translation between English and the student's first language
- Materials presented at lower TC levels
- Audio books
- Use of interactive English vocabulary websites *(Learning Chocolate)*
- Small flip book of content specific vocabulary with translations and pictures

Gifted and Talented

- Ask students to explain how the spines of a cactus and the feathers of a hawk might help these organisms survive in a desert environment
- Help students make sequential diagrams to show how a canyon forms as the result of changes by water to Earth's surface
- Provides students with a map similar to the one shown on *Exploring Science pg. 146-147*, but without any of the features in place. Challenge them to locate the major mountain ranges on each continent (except Antarctica), to draw in the mid-ocean ridges, and to locate some of the deep ocean trenches. Remind students, if needed, to generate a key explaining the symbols that they used to show the features on their maps.
- Challenge questions and higher level thinking while reading both fiction and nonfiction texts
- Higher TC level texts
- Advanced STEAM activities
- Assigned leadership roles within class

Students with 504 Plans
● *Have students complete sentence stems, such as: The weather in the Pacific Northwest can be described as . . . Some of the plants that live there include . . . Some of the animals in this region include . .* ● *Connect concepts to real life: Ask: What happens when a drop of water lands on a paper towel? (It is absorbed.) What happens when a drop of water lands on a piece of plastic wrap? (It does not go through the wrap.) Which material is more like the skin of a reptile or stem of a cactus? Explain. (The plastic wrap is more like the outer coverings of these living things because it prevents water from moving through it.)* ● *H*elp students explain how erosion and deposition shape and change the land: *Help students compare and contrast these processes by providing sentence stems, such as: Erosion is . . . Deposition is . . . Things that cause erosion and deposition include…* ● *Have students complete sentence stems, such as: Natural hazards cannot . . . but their impacts . . . Cables on bridges in earthquake-prone areas help prevent damage by . . . Links on bridges in earthquake-prone areas help prevent damage by . .* ● *A*sk either/or questions to help students explain their thinking ● Provide sentence frames and sentence stems to explain their understanding of processes that shape the Earth ● Extended time for assignment ● Prompting ● Reassurance ● Time to formulate ideas ● Use of visual clues when reading ● Preferential seating ● Repeated directions ● Instructional Aides in the classroom setting ● Peer models ● Preview content vocabulary and schema ● Use of FM system to improve attention and support auditory information ● Behavior chart to increase focus and work completion ● Sensory breaks ● Chromebook extensions *(text-to-speech)* ● Graphic organizers

Appendix A
3-5 Engineering Design Standards

Students who demonstrate understanding can:
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.

Disciplinary Core Ideas

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)

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- 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

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- 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. (3-5-ETS1-3)

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 problem. (3-5-ETS1-2)

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

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)