Science - Grade 4

Unit #: 1	**Unit Topics:** Weathering and Erosion/Earth's Processes	**Pacing:** 20 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS

4-ESS1-1. **Earth's Place in the Universe**

- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

4-ESS2-1. **Earth's Systems**

- Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

4-ESS2-2. **Earth's Systems**

- Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

4-ESS3-2. **Earth and Human Activity**

- Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

3-5-ETS1-2. **Engineering Design**

- 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. **Engineering Design**

- 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.

English Language Arts Standards:

- Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1) **W.4.7**
- 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-ESS2-1),(4-ESS1-1)**W.4.8**
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1) **W.4.9**
- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2) **RI.4.1**
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2) **RI.4.7**
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2) **W.4.7**
- Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2) **RI.4.9**
- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2) **RI.5.1**
- Draw on information from multiple print or digital sources, demonstrating theability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS1-2) **RI.5.1**
- Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2) **RI.5.9**
- Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-3) **W.5.7**
- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-3) **W.5.8**
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-3) **W.5.9**

Mathematics Standards:

- Reason abstractly and quantitatively. (4-ESS2-1), (4-ESS1-1) **MP.2**
- Model with mathematics. (4-ESS2-1), (4-ESS1-1) **MP.4**
- Use appropriate tools strategically. (4-ESS2-1) **MP.5**
- Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1), (4-ESS1-1) **4.MD.A.1**
- 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.MD.A.2**
- Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ 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) **4.OA.A.1**
- Operations and Algebraic Thinking (3-ETS1-2) **3-5.OA**

Enduring Understandings *Students will understand…*	Essential Questions *Students will consider...*
ESS2.A: Earth Materials and Systems ● Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.E: Biogeology** ● Living things affect the physical characteristics of their regions. (4-ESS2-1) **ESS1.C: The History of Planet Earth** ● Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1) **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) **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*) **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)	● How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured? ● What can rock formations tell us about the past? ● What can maps tell us about the features of the world? ● In what ways can the impacts of natural Earth processes on humans be reduced?

Knowledge *Students will know…*	Academic Vocabulary
• Cause-and-effect relationships are routinely identified, tested, and used to explain change. • Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. • Rainfall helps to shape the land and affects the types of living things found in a region. • Living things affect the physical characteristics of their regions. • Science assumes consistent patterns in natural systems. • Patterns can be used as evidence to support an explanation. • Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. • The presence and location of certain fossil types indicate the order in which rock layers were formed. • 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. • Engineers improve existing technologies or develop new ones to increase benefits, decrease known risks, and meet societal demands. • A variety of hazards result from natural processes (e.g., earthquakes, floods, tsunamis, volcanic eruptions). • Humans cannot eliminate the hazards, but they can take steps to reduce their impacts. • 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. • At whatever stage, communicating with peers about proposed solutions to a problem is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	• rock formations • fossils • landscape • weathering • erosion • rocks • soils • sediment • vegetation • marine • physical characteristics • continents • oceans • trenches • mountain range • hazards • earthquakes • volcanos • topographic map • geologist

Skills

Students will be able to…

- Identify, test, and use cause-and-effect relationships in order to explain change.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- Make observations and/or measurements to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. *(Note: Assessment is limited to a single form of weathering or erosion.)* Examples of variables to test could include:
    - 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
- Support explanations using patterns as evidence.
- Identify the evidence that supports particular points in an explanation.
- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. *(Note: 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.)* 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.
- Analyze and interpret data to make sense of phenomena using logical reasoning.
- 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
- Generate multiple solutions to a problem and compare them based on how well they meet the criteria and constraints of the design solution.
- Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans *(Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.)* Examples of solutions could include:
    - Designing an earthquake-resistant building
    - Improving monitoring of volcanic activity.

- 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.
- 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.

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ DOE Model Curriculum

NJ Model Curriculum Unit 1: What do the shapes of landforms and rock formations tell us about the past?

In this unit of study, students develop understandings of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. The crosscutting concepts of patterns and cause and effect are called out as organizing concepts. Students demonstrate grade-appropriate proficiency in planning and carrying out investigations and constructing explanations. Students are also expected to use these practices to demonstrate understanding of the core ideas.

NJ Model Curriculum Unit 2: Is it possible to engineer ways to protect humans from natural Earth?

In this unit of study, students apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. The crosscutting concepts of patterns, cause and effect, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

SUMMATIVE ASSESSMENT:

Summative Assessment 1:
*Standards:*4-ESS2-1
Type: Lab
Overview: Through this hands on activity, students explore different forms of erosion: chemical, **water, wind, glacier,** and temperature. They will rotate through stations and model each type of erosion on rocks, soils, and minerals. Students will record observations and discuss the effects of erosion on the Earth's landscape.

- Students use materials such as water, soil, and rocks to model erosion.

*Rubric:*http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: https://www.teachengineering.org/activities/view/cub_earth_lesson5_activity1

OR (Decide as a grade level which to use as a summative)
Summative Assessment 2:
Standards: 4-ESS2-1, 3-5-ETS1-2
Type: Lab
Overview: Through this hands on activity, students explore different forms of weathering and erosion by plants, wind, water, and ice. Coastal erosion is also explored. Students keep a science notebook and make observations. They will design a model showing how humans can slow erosion.
Rubric: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link has several links for an entire weathering unit. As a grade level, we will decide which lab to complete as a summative assessment)

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Exit Tickets	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities

From the NJ Model Curriculum Unit 1:

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 should build and use models that demonstrate how wind, water, and ice cause change to the surface of the earth. Students should 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 to understand the effects of water and ice on land, students should 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.

Suggested Learning Activities Continued

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.

From the NJ Model Curriculum Unit 2:

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 ü 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.

Resources/Instructional Materials

(articles, novels, websites, books, magazines, art, media)

- NJ DOE Model Curriculum Unit 1- http://www.nj.gov/education/modelcurriculum/sci/4u1.pdf
- NJ DOE Model Curriculum Unit 2- http://www.nj.gov/education/modelcurriculum/sci/4u2.pdf
- **Glaciers, Water, and Wind, Oh My!** (http://ngss.nsta.org/Resource.aspx?ResourceID=35) -This hands-on activity allows students to explore five earth forces that may cause erosion as they model, observe, and record the effects of erosion on earth surfaces. Stations include demonstrations of chemical, wind, water, ice and heat forces as they affect weathering.
- **Coastal Erosion**: (http://ngss.nsta.org/Resource.aspx?ResourceID=106)-This engineering design lesson focuses on the effects of erosion on Florida's coastline. It is one lesson offered within a larger weathering and erosion unit. Students groups work to create and use a model able to slow erosion, without damaging the coastal ecosystem. Students are responsible for developing scale diagram of their coastline erosion solution before building and testing their models in a pan to simulate the coastline. Students then complete a redesign cycle. Similar lessons from the developer can be used in conjunction with this lesson to incorporate the effects of erosion on humans and wildlife.
- **Gary's Sand Journal:** (http://ngss.nsta.org/Resource.aspx?ResourceID=45)-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.
- **Bill Nye Video on Erosion** (23 minutes) (https://www.schooltube.com/video/9522ccca25154ea897ff/Bill%20Nye%20erosion)- 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.
- **Engineering for the Three Little Pigs:** (https://www.teachengineering.org/activities/view/cub_earth_lesson1_activity1 ()-This activity helps to demonstrate the importance of rocks, soils, and minerals in engineering and how using the right material for the right job is important. The students build 3 different sand castles composed of varying amounts of sand, water, and glue. The 'buildings' in this lesson are made of sand and glue, sand being a soil and glue being composed of different minerals. They then test them for strength (load bearing), and resistance to weathering. The students will then compare possible solutions and discuss how well each is likely to work while meeting the criteria and constraints of the problem. The students will be the engineers who figure out which materials are best for the buildings they are making, taking into consideration all the properties of materials that are discussed in the lesson.
- **Earthquakes in the Classroom**: (https://www.teachengineering.org/activities/view/cub_natdis_lesson03_activity1)Students investigate which building types are structured to withstand earthquake damage. They take on the role of engineers as they design their own earthquake resistant buildings, then test them in a simulated earthquake activity. Students also develop an appreciation for the job of engineers who need to know about earthquakes and their causes in order to design resistant buildings. This lesson is one of several in the "Earthquakes Rock" unit provided by the Teach Engineering site. The unit "URL" listed here is not being reviewed for the Performance Expectation listed. It is offered as a supplemental concept and lesson background aid for teachers. https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_natdis/cub_natdis_lesson03.xml
- **Getting the Right Angle on the Story**: (https://spaceplace.nasa.gov/tsunami/en/)-This informational text shows students how tsunamis form and behave. It also describes how scientists are collecting data to create models that can be used to predict tsunamis. Animations/computer models are also included to enhance student knowledge of how tsunami warnings work. Models integrate new, unfamiliar vocabulary. Students could use the resource as a starting point for an earth systems unit; teachers could assign the site as a form of research where students gather data, take notes, and draw inferences from text. As students begin their study, they could generate a list of the earth's natural disasters and define their impact on human life and the environment. Their possible solutions for lessening that impact could also be incorporated as an informal formative assessment to determine student prior knowledge.
- **DLESE Earth Science Literacy Maps** (http://www.dlese.org/library/literacy_maps/)-are a tool for teachers and students to find resources that relate to specific Earth science concepts. These maps illustrate connections between concepts and how they build upon one another across grade levels. Clicking on a concept within the maps will show DLESE resources related to the concept, as well as information about related AAAS Project 2061 Benchmarks and National Science Education Standards.
- **Fossils Lab**- (http://www.uen.org/Lessonplan/preview.cgi?LPid=16320) -Activity in which kids are out of their seats and drawing different fossils. They will explore why the fossils are where they are.
- **Researching Fossils- (** https://betterlesson.com/lesson/631527/researching-fossils)-Better Lesson- Students use the Website "Fossils for Kids" to find out some fantastic facts about how fossils tell us that the earth has changed.

Resources/Instructional Materials Continued

- **Building the Grand Canyon- (** https://betterlesson.com/lesson/636543/building-the-grand-canyon)- Better Lesson- The Grand Canyon is an excellent model for learning about Earth's rock formations. Students will look at fossils and the differences in layers to understand how the Earth changed over time.
- **Earth Science UNIT TEST- (** https://betterlesson.com/lesson/614520/earth-science-unit-test)- Better Lesson - Unit Test that covers fossil layers and a bit of erosion.
- **What's with that crazy Nye Guy? Weathering One More time! Day 1** (https://betterlesson.com/lesson/635296/what-s-with-that-crazy-nye-guy-weathering-one-more-time-day-1)- Better Lesson- Lesson goes along with the Bill Nye video posted above.
- **What's with that crazy Nye Guy? Weathering One More time! Day 2 (** https://betterlesson.com/lesson/635688/what-s-with-that-crazy-nye-guy-weathering-one-more-time-day-2) - Better Lesson follow up to above lesson- Choice and creativity are key in this collaborative effort to produce a presentation of new extra facts learned, helping them to connect weathering to the real world.
- **Dunes (** https://betterlesson.com/lesson/629396/dunes) -Better lesson- In this math and science integrated lesson, students explore how wind affects sand by making a mini dune and exposing it to wind.
- **My Super Fantabulous Terrific Science Notebook** (https://betterlesson.com/lesson/627689/my-super-fantanbulous-terrific-science-notebook)- Better Lesson- When students complete this lesson, they will have an interactive notebook specifically designed to support their personal learning.

Technology Resources

- Mystery Science
- Kahoot!
- Brainpop
- Quizlet
- Better Lesson
- Google Classroom
- Youtube
- Discovery Education
- Zunal
- Scholastic

Accommodations & Modifications

for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science - Grade 4

Unit #: 2	**Unit Topics:** Structure and Function/How Organisms Process Information	**Pacing:** 20 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS

4-LS1-1. **From Molecules to Organisms:Structures and Processes**

- Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

4-LS1-2. **From Molecules to Organisms: Structures and Processes**

- 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. [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 the mechanisms of how sensory receptors function.]

4-PS4-2. Waves and their Applications in Technologies for Information Transfer

- Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

English Language Arts Standards:

- Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1) **W.4.1**
- Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2),(4-LS4-2) **SL.4.5**

Mathematics Standards:

- 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) **4.G.A.3**
- Model with mathematics. (4-PS4-2) **MP.4**
- 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.1**

Enduring Understandings ***Students will understand…***	**Essential Questions** ***Students will consider...***
LSI.A: Structure and Function ● Plants and Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproductions (4-LS1-1) **LSI.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) **PS4.B: Electromagnetic Radiation** ● An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)	● How do internal and external parts of plants and animals help them to survive, grow, behave, and reproduce? ● How do animals receive and process different types of information from their environment in order to respond appropriately? ● What happens when light from an object enters the eye?
Knowledge ***Students will know…***	**Academic Vocabulary**
● A system can be described in terms of its components and their interactions. ● Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● 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. ● Cause-and-effect relationships are routinely identified. ● An object can be seen when light reflected from its surface enters the eyes.	● internal ● external ● structures (thorns, stems, roots, colored petals, heart, stomach, lung, brain, skin) ● function ● senses ● sense organs ● reflection ● sense receptors ● organisms ● living system

Skills

Students will be able to…

- Describe a system in terms of its components and their interactions.
- Construct an argument with evidence, data, and/or a model.
- 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. (Assessment is limited to macroscopic structures within plant and animal systems.) Examples of structures could include: thorns, stems, roots, colored petals, heart, stomach, lung, brain, skin.
- Use a model to test interactions concerning the functioning of a natural system.
- 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.
    - Emphasis is on systems of information transfer.
    - Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.
- Identify cause-and-effect relationships.
- Develop a model to describe phenomena.
- Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works).

21ST Century/ Interdisciplinary Themes	**21st Century Skills**
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ DOE Model Curriculum

Model Curriculum Unit 3: How do the internal and external parts of plants and animals support their survival, growth, behavior, and reproduction.
In this unit of study, students develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. The crosscutting concepts of systems and system models are called out as organizing concepts for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency in engaging in argument from evidence. Students are also expected to use this practice to demonstrate understanding of the core idea.

Model Curriculum Unit 4: How do animals use their perceptions and memories to make decisions?.
In this unit of study, students are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. The crosscutting concepts of cause and effect, systems and system models, and structure and function are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in developing and using models. Students are expected to use these practices to demonstrate understanding of the core ideas.

SUMMATIVE ASSESSMENT:

Summative Assessment 1:
Standards: 4-LS1-1
Type: Exam
Overview: Students will synthesize information gathered throughout the unit by completing the end of unit exam

- Students will be asked to prove plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Rubric:
Resources: Student science notebooks

Summative Assessment 2:
Standards: 4-LS1-2
Type: Lab
Overview: In this activity, students make a pinhole camera and see images formed on an internal screen. They then use a lens to see how this affects the images. Students investigate variables in its construction, and explore how it models the human eye's ability to receive and process information. Students will draw models of how light enters the human eye and relate this to the pinhole cameras.
Rubric: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: *http://ngss.nsta.org/Resource.aspx?ResourceID=88*

Formative Assessments	***Student Self-Assessment***	***Common Assessments***
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Exit Tickets	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities

From the NJ Model Curriculum Unit 3:

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.

From the NJ Model Curriculum Unit 4:

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, which might include the following steps:

Resources/Instructional Materials

(articles, novels, websites, books, magazines, art, media)

- NJ DOE Model Curriculum Unit 3- http://www.nj.gov/education/modelcurriculum/sci/4u3.pdf
- NJ DOE Model Curriculum Unit 4- http://www.nj.gov/education/modelcurriculum/sci/4u4.pdf
- **Animal Mouth Structures-** (https://nj.pbslearningmedia.org/resource/tdc02.sci.life.colt.lp_mouths/animal-mouth-structures/#.WWzvvtQrK1s)-In this lesson, students gather evidence to understand features that enable them to meet their needs. In particular, they examine the mouth structures of different animals to help them understand how animals are adapted to obtain food in their environment.
- **Pinhole Camera and Eyes- (** http://ngss.nsta.org/Resource.aspx?ResourceID=88)- In this activity, students make a pinhole camera and see images formed on an internal screen. They then use a lens to see how this affects the images. Students investigate variables in its construction, and explore how it models the human eye's ability to receive and process information.
- **The Life of Environments- (** http://ngss.nsta.org/Resource.aspx?ResourceID=189)- This unit is designed to address the concept that organisms sense the environment in order to live. It is a far-ranging and comprehensive unit that is designed to address multiple NGSS performance expectations (4-LS1-2, 4LS1-2, 4-PS3-2, 4-PS4-2) in seven explorative sections, with an additional summative assessment step.
- **Busy Bees-** (https://betterlesson.com/lesson/640362/busy-bees)- Better Lesson- Students research bees and how their specialized body parts help them in survival and contribute to the success of plant survival and reproduction.
- **That's not a Plant, It's a Weed! Discovering Functions of External Plant Parts** (https://betterlesson.com/lesson/603965/that-s-not-a-plant-it-s-a-weed-discovering-functions-of-external-plant-parts-what-makes-a-plant-a-plant)- Better Lesson- Using data and prior knowledge, students use Educreations to explain their observations, measurements and understanding of various plant's external parts and how they help the plant survive in its environment.
- **Monster Plants-** (https://betterlesson.com/lesson/617285/monster-plants)- Better Lesson- 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.
- **Disecting Daffodils-** (https://betterlesson.com/lesson/640175/dissecting-daffodils)- Better Lesson- Students dissect daffodils to observe the internal and external parts of the plant in order to better understand how they survive and reproduce.
- **Organs of the Human Body- (** https://betterlesson.com/lesson/618161/organs-of-the-human-body)- Better Lesson- Human organs accomplish necessary functions within the human body. Each organ has a distinct role within a body system.
- **The Muscular System- (** https://betterlesson.com/lesson/631595/the-muscular-system **)-** Better Lesson-Major muscle groups allow the human body to move and accomplish tasks.
- **Heart Rate and Respiration-** (https://betterlesson.com/lesson/618162/heart-rate-and-respiration)- Better Lesson- Heart rate and respiration change with exertion. The changes correlate.
- **Who Turned out the Lights?- (** https://betterlesson.com/lesson/617379/who-turned-out-the-lights)- Better Lesson - Students use lines, rays and diagrams to explain how light rays reflecting on an object help us see the object.
- **Understanding the Eye** (https://betterlesson.com/lesson/637886/understanding-the-eye)- Better Lesson- In this lesson, students learn how our eye uses light to be able to see color.
- **ASSESSMENT of Understanding the Eye**- (https://betterlesson.com/lesson/637888/assessment-of-understanding-how-light-energy-enters-the-eye)- Better Lesson- Students create a model eye in order to demonstrate their understanding of how the eye works. This goes with the lesson above.

Technology Resources

- Mystery Science
- Kahoot!
- Brainpop
- Quizlet
- Better Lesson
- Google Classroom
- Youtube
- Discovery Education
- Zunal
- Scholastic

Accommodations & Modifications

for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science - Grade 4

Unit #: 3	**Unit Topics:** Transfer of Energy	**Pacing:** 15 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS

4-PS3-2. **Energy**

- Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-ESS3-1. Earth and Human Activity

- Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; nonrenewable 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.]

English Language Arts Standards:

- Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-ESS3-1) **W.4.7**
- Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-2),(4-ESS3-1) **W.4.8**
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS3-1) **W.4.9**

Mathematics Standards:

- Reason abstractly and quantitatively. (4-ESS3-1) **MP.2**
- Model with mathematics. (4-ESS3-1) **MP.4**
- 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-ESS3-1) **4.OA.A.1**

Enduring Understandings ***Students will understand…***	**Essential Questions** ***Students will consider...***
PS3.A: Definitions of Energy ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2) ● The faster a given object is moving, the more energy it possesses. (4-PS3-1) **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) ● 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) **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)	● How does energy move? ● From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?
Knowledge ***Students will know…***	**Academic Vocabulary**
● Energy can be transferred in various ways and between objects. ● Energy can be moved from place to place through sound, light, or electric currents. ● Energy is present whenever there are moving objects, sound, light, or heat. ● Light also transfers energy from place to place. ● Energy can also be transferred from place to place by electric currents; the currents may have been produced to begin with by transforming the energy of motion into electrical energy. ● Cause-and-effect relationships are routinely identified and used to explain change. ● Knowledge of relevant scientific concepts and research findings is important in engineering. ● Over time, people's needs and wants change, as do their demands for new and improved technologies. ● Energy and fuels that humans use are derived from natural sources. ● The use of energy and fuels from natural sources affects the environment in multiple ways. ● Some resources are renewable over time, and others are not.	● energy ● energy transfer ● convert ● stored energy ● motion energy ● fuels ● natural resources ● sound ● light ● heat ● electrical current ● renewable ● nonrenewable

Skills

Students will be able to…

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

21ST Century/ Interdisciplinary Themes	**21st Century Skills**
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence

from the NJ DOE Model Curriculum

From Model Curriculum Unit 5: Where do we get the energy we need for modern life?

In this unit of study, fourth-grade students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents. Students also obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. The crosscutting concepts of cause and effect, energy and matter, and the interdependence of science, engineering, and technology, and influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations and obtaining, evaluating, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Stage 2- Assessment Evidence Continued

Summative Assessment 1:

- *Standards:* 4-PS3-2
- *Type:* Lab
- *Overview:* Students will rotate through stations to conduct mini-labs on energy transfer
    - Heat transfer- Hot water is poured into a large styrofoam cup. A smaller plastic cup with cold water is placed inside. Students place a thermometer in each cup. They will observe and record results in science notebook. They should be able to explain that heat was transferred from the hot to the cold.
    - Electric Current transfer- Students must build simple electric circuits which will light a bulb or ring a buzzer. They will record their process and results in science notebook. They should note that the stored energy in the battery is transferred to electric energy which is then transferred into either light or sound energy.
    - Motion energy transfer- Throw a ball against the wall. Observe the motion energy transferred into sound energy.
- *Rubric:* http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
- *Resources:* Science notebook, Lab materials

Summative Assessment 2:

- *Standards:* 4-ESS3-1
- *Type:* Research Simulation Task (Writing)
- *Overview:* Students conduct research on human use of natural resources. They should select a resource and research how its use affects the environment.
- *Rubric:* ELA Rubric
- *Resources:* Google

Formative Assessments	***Student Self-Assessment***	***Common Assessments***
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Exit Tickets	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities

From the 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.

Resources/Instructional Materials
(articles, novels, websites, books, magazines, art, media)

- **Switch Energy Project- (** http://switchenergyproject.com/education/) - The Educator Portal provides free access to a documentary, energy labs, videos, and study guides.
- **Wind Generator**: (https://concord.org/stem-resources/wind-generator)- Windmills have been used for hundreds of years to collect energy from the wind in order to pump water, grind grain, and more recently generate electricity. There are many possible designs for the blades of a wind generator and engineers are always trying new ones. Design and test your own wind generator, then try to improve it by running a small electric motor connected to a voltage sensor.
- **Thermal Energy Transfer:** (https://nj.pbslearningmedia.org/resource/lsps07-sci-phys-thermalenergy/thermal-energy-transfer/#.WXCq0NTyu70) Explore the three methods of thermal energy transfer: conduction, convection, and radiation, in this interactive from WGBH, through animations and real-life examples in Earth and space science, physical science, life science, and technology.

Resources/Instructional Materials Continued

- **The Lightbulb Just Went On** (https://betterlesson.com/lesson/637885/the-lightbulb-just-went-on)-Better Lesson- Turn your students loose using batteries and lightbulbs so they totally explore how they can light the bulb using engineering practices and discovery.
- **Creative Circuits** (https://betterlesson.com/lesson/637884/creative-circuits)- Better Lesson- Students get a chance to be creative as they explore how salt dough will conduct electricity and convert it to light energy.
- **What is Energy?** (https://betterlesson.com/lesson/623247/what-is-energy)- Better Lesson- In this lesson students participate in an internet search to investigate the definition of energy and discover the two main types of energy, kinetic and potential energy.
- **Bright Time with Circuits** (https://betterlesson.com/lesson/614362/bright-time-with-circuits)- Better Lesson- In this lesson, students use batteries, bulbs, and tinfoil to demonstrate how energy can be transferred from one object to another.

Technology Resources

- Mystery Science
- Kahoot!
- Brainpop
- Quizlet
- Better Lesson
- Google Classroom
- Youtube
- Discovery Education
- Zunal
- Scholastic

Accommodations & Modifications
for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational “breaks” as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science - Grade 4		
Unit #: 4	**Unit Topics:**Force of Motion//Using Engineering Design with Force and Motion Systems	**Pacing:** 30 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS

4-PS3-1. Energy

- Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

4-PS3-3. Energy

- Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-4. Energy

- Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

3-5-ETS1-1. Engineering Design

- 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. Engineering Design

- 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. Engineering Design

- 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.

English Language Arts Standards:

- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1) **RI.4.1**
- Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1) **RI.4.3**
- Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1) **RI.4.9**
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1) **W.4.2**
- Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-ESS3-1) **W.4.7**
- Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-2),(4-ESS3-1) **W.4.8**
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS3-1) **W.4.9**
- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2) **RI.5.1**

English Language Arts Standards:

- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS1-2) **RI.5.1**
- Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3) **W.5.7**
- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-1),(3-5-ETS1-3) **W.5.8**
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1),(3-5-ETS1-3) **W.5.9**

Mathematics Standards:

- Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4) **4.OA.A.3**
- Operations and Algebraic Thinking (3-ETS1-1),(3-ETS1-2) **3.OA**
- Reason abstractly and quantitatively. (4-ESS3-1) **MP.2**
- Model with mathematics. (4-ESS3-1) **MP.4**
- Use appropriate tools strategically. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) **MP.5**

Enduring Understandings ***Students will understand…***	**Essential Questions** ***Students will consider...***
PS3.A: Definitions of Energy ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2) ● The faster a given object is moving, the more energy it possesses. (4-PS3-1) **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer** ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2) **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) **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)	● What is the relationship between the speed of an object and its energy? ● In what ways does energy change when objects collide? ● How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

Knowledge ***Students will know…***	**Academic Vocabulary**
• Energy can be transferred in various ways and between objects. • Energy can be moved from place to place through sound, light, or electric currents. • Energy is present whenever there are moving objects, sound, light, or heat. • Over time, people's needs and wants change, as do their demands for new and improved technologies. • The faster a given object is moving, the more energy it possesses. • 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. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. • When objects collide, the contact forces transfer energy so as to change the objects' motions. • Science affects everyday life. • Most scientists and engineers work in teams. • Engineers improve existing technologies or develop new ones. • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. • 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. • The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. • Possible solutions to a problem are limited by available materials and resources (constraints). • The success of a designed solution is determined by considering the desired features of a solution (criteria). • Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. • 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. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	• energy • energy transfer • convert • stored energy • motion energy • speed • collide/collision • problem • needs/wants/societal demands • solution • fair tests • variables • control • model • prototype

Skills

Students will be able to…

- Describe the various ways that energy can be transferred between objects.
- Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
- Use evidence to construct an explanation relating the speed of an object to the energy of that object. *(Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.)*
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Ask questions and predict outcomes about the changes in energy that occur when objects collide. Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. *(Assessment does not include quantitative measurements of energy.)*
- Apply scientific ideas to solve design problems.
- Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (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.)
- Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.
- 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.
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
- 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.
- 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.
- 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.

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ DOE Model Curriculum

From the Model Curriculum Unit 6: What is the relationship between the speed of an object and the energy of that object?

In this unit of study, students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object, and are expected to develop an understanding that energy can be transferred from object to object through collisions. The crosscutting concept of energy and matter is called out as an organizing concept. Students are expected to demonstrate grade-appropriate proficiency in asking questions, defining problems, and constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

From the NJ Model Curriculum Unit 7: How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

In this unit of study, students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from objects through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of energy and matter and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, planning and carrying out investigations, constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate their understanding of the core ideas.

Summative Assessment 1:

Standards: 4-PS3-4, 4-PS3-1
Type: Lab
Overview: Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of twists in the rubber band or changing other design features. Students relate the speed of the object to the stored energy in the object.
Rubric: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: https://nj.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsplcar/potential-and-kinetic-energy-spool-racer/#.WXCv4tTyu70

AND/OR

Summative Assessment 2:

Standards: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3, 4-PS3-4
Type: Lab
Overview: Students will complete a "Design Challenge". Design and build a simple device that converts energy from one form to another (motion energy to electric energy OR stored energy to cause motion or produce light or sound.). Students will research objects with "stored energy" such as stretched rubber bands, batteries, wind up toys, etc. Students work in small groups to build their device. Students will create a poster to display the energy transfer.
Rubric: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: Lab materials

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Exit Tickets	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities

From the 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.

From the NJ Model Curriculum Unit 7:

Note: In the prior unit of study, students observed objects in motion in order to understand the relationship between the speed of an object and its energy, and they investigated the transfer of energy from one object to another, as well as from one form to another. In this unit, students will apply scientific ideas about force, motion, and energy in order to design, test, and refine a device that converts energy from one form to another. Through this process, students will learn that science affects everyday life and that engineers often work in teams, using scientific ideas, in order to meet people's needs for new or improved technologies.

To begin the engineering design process, students must be presented with the problem of designing a device that converts energy from one form to another. This process should include the following steps:

- As a class, students should create a list of all the concepts that they have learned about force, motion, and energy.
    - The faster a given object is moving, the more energy it possesses.
    - Energy is present whenever there are moving objects, sound, light, or heat.
    - Energy can be transferred in various ways and between objects.
    - 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. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
    - When objects collide, the contact forces transfer energy so as to change the objects' motions.
- Have students brainstorm examples of simple devices that convert energy from one form to another. As students give examples, the teacher should draw one or two and have students describe how each device converts energy from one form to another.
- Next, the teacher can present a "Design Challenge" to students: Design and build a simple device that converts energy from one form to another. Please note that teachers should limit the devices to those that convert motion energy to electric energy or that use stored energy to cause motion or produce light or sound.
- Small groups of students should conduct research, using several sources of information, to build understanding of "stored energy." Students can look for examples of objects that have stored energy. Stretched rubber bands, compressed springs, wound or twisted rubber bands, batteries, wind-up toys, and objects at the top of a ramp or held at a height above the ground all have stored energy.
- As a class, determine criteria and possible constraints on the design solutions. For example, devices are only required to perform a single energy conversion (i.e., transfer energy from one form to another), and devices must transfer stored energy to motion, light, or sound. Constraints could include the use of ü materials readily available in the classroom or provided by the teacher. (An assortment of materials can be provided, including batteries, wires, bulbs, buzzers, springs, string, tape, cardboard, balls, rubber tubing, suction cups, rubber bands of various sizes, construction paper, craft sticks, wooden dowels or skewers, buttons, spools, glue, brads, paper clips, plastic cups, paper plates, plastic spoons, straws, Styrofoam, and cloth.) A time constraint could also be set, if desired. All criteria and constraints should be posted on chart paper so that groups can refer to them as needed.
- Students should work in small, collaborative groups to design and build their device. Examples of possible devices could include:
    - A simple rubber band car that converts the stored energy in a twisted rubber band into motion energy.
    - A simple roller coaster that converts the stored energy in a marble held at the top of the roller coaster into motion energy.
    - A whirly bird that converts stored energy (in a student's muscles) into motion energy.
    - A ball launcher that converts stored energy in a compressed spring, compressed suction cup, or stretched rubber band into motion energy when the ball is launched.
- Students should create a poster that includes a diagram of the device and a description of how the device transfers energy from one form to another. Every group should have the opportunity to present their device and explain how it works.
- As a class, students compare each of the design solutions based on how well they meet criteria and constraints, giving evidence to support their thinking. When giving feedback to the groups, students should identify which criteria were/were not met, and how the design might be improved.
- Small groups should then have the opportunity to refine their designs based on the feedback from the class.
- At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. It is also important that students describe the ways in which energy is transferred between objects and from one form to another.

Resources/Instructional Materials

(articles, novels, websites, books, magazines, art, media)

- **Spool Racers**: (https://nj.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsplcar/potential-and-kinetic-energy-spool-racer/#.WXCv4tTyu70)-This resource includes three parts: a video clip from the TV show, Zoom, to introduce the activity, an essay with background information about energy, and a set of printable instructions. Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of twists in the rubber band or changing other design features. These websites provide additional ideas for modifying the basic rubber band racer design: http://www.scienceworld.ca/resources/activities/popcan-porsche and http://pbskids.org/designsquad/build/rubber-band-car/.
- **Force and Motion Video 3 min**: (https://nj.pbslearningmedia.org/resource/idptv11.sci.phys.maf.d4kfom/force-and-motion/#.WXCxUNTyu70)- This video segment from IdahoPTV's D4K defines gravity, force, friction and inertia through examples from amusement park rides. Examples and explanations of Sir Isaac Newton's Three Laws of Motion are also included.

Resources/Instructional Materials Continued

- **Advanced High-Powered Rockets: https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Advanced_High_Power_Paper_Rockets.html#.VsxeJPkrJD8 -** Students select a flight mission (what they want the rocket to do) and design and construct a high-power paper rocket that will achieve the mission. They construct their rocket, predict its performance, fly the rocket, and file a post-flight mission report. Missions include achieving high altitude records, landing on a "planetary" target, carrying payloads, testing a rocket recovery system, and more.
- **The Sound of Science**: (http://www.nsta.org/store/product_detail.aspx?id=10.2505/4/sc14_051_06_30)- Students are given a scenario/problem that needs to be solved: Their school is on a field trip to the city to listen to a rock band concert. After arriving at the concert, the students find out that the band's instruments were damaged during travel. The band needs help to design and build a stringed instrument with the available materials, satisfying the following criteria and constraints: 1) Produce three different pitched sounds. 2) Include at least one string. 3) Use only available materials. 4) Be no longer than 30 cm / 1 foot. The challenge is divided into 4 activities. Each activity is designed to build on students' understanding of the characteristics and properties of sound. By using what they learn about sound from these activities, students are then encouraged to apply what they know about sound to complete the engineering design challenge.
- **Energy Makes Things Happen: The Boy Who Harnessed the Wind:** (http://ngss.nsta.org/Resource.aspx?ResourceID=253)-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.
- **Balloon Rockets Launch New Learning (https://betterlesson.com/lesson/614949/balloon-rockets-launch-new-learning)**- Better Lesson - In this inquiry based lesson, students work with partners to build rockets with balloons, string, and straws. Students work with altering variables in order to observe how energy and speed are related.
- **Colliding Marbles** (https://betterlesson.com/lesson/628399/colliding-marbles)- Better Lesson- In this lesson, students use marbles of various sizes to see how collisions can transfer energy from one object to another.
- **Engineering Project: Marshmallow Catapult** (https://betterlesson.com/lesson/628156/engineering-project-marshmallow-catapult)- Better Lesson- Students will act just as real scientists by working through the engineering design process to plan, build, and a test a catapult they made from craft sticks and rubber bands.
- **Engineering Project: Balloon Car** (https://betterlesson.com/lesson/628155/engineering-project-balloon-car)- Better Lesson- Students act just as real scientists do, to create and test a vehicle they have designed, that is powered by only a balloon.

Technology Resources

- Mystery Science
- Kahoot!
- Brainpop
- Quizlet
- Better Lesson
- Google Classroom
- Youtube
- Discovery Education
- Zunal
- Scholastic

Accommodations & Modifications

for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

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Science - Grade 4

Unit #: 5	**Unit Topics:** Waves and Information	**Pacing:** 15 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards

4-PS4-1. **Waves and their Applications in Technologies for Information Transfer**

- Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

4-PS4-3. **Waves and their Applications in Technologies for Information Transfer**

- Generate and compare multiple solutions that use patterns to transfer information.* [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

3-5-ETS1-2. **Engineering Design**

- 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. **Engineering Design**

- 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.

English Language Arts Standards

- Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3) **RI.4.9**
- Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1) **SL.4.5**
- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS1-2) **RI.5.1**
- Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2) **RI.5.9**
- Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-3) **W.5.7**
- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-3) **W.5.8**
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-3) **W.5.9**

Mathematics Standards:

- Reason abstractly and quantitatively. (3-5-ETS1-2),(3-5-ETS1-3) **MP.2**
- Model with mathematics. (4-PS4-2),(3-5-ETS1-2),(3-5-ETS1-3) **MP.4**
- Use appropriate tools strategically. (3-5-ETS1-2),(3-5-ETS1-3) **MP.5**
- Operations and Algebraic Thinking (3-ETS1-2) **3-5.OA**
- 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.1**

Enduring Understandings *Students will understand…*	Essential Questions *Students will consider...*
PS4.A: Wave Properties ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)**PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) ● 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)* **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)	● If a beach ball lands in the surf, beyond the breakers, what will happen to it? ● Which team can design a way to use patterns to communicate with someone across the room?

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

Skills

Students will be able to…

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

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

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ DOE Model Curriculum

How can we use waves to gather and transmit information?

In this unit of study, students use a model of waves to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move. The crosscutting concepts of patterns; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, and constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate their understanding of the core ideas.

Summative Assessment 1:

Standards: 4-PS4-1
Type: Lab
Overview: Students will model the properties of waves by disturbing the surface of water in a variety of pans and buckets. Students will record observations in science notebooks as they strike the water with different sized objects and different force. Students will develop a model using drawings, diagrams or 3D objects (slinky, jump rope, etc.) to show the basic properties of waves.
*Rubric:*http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: Lab materials. "Learning Activities" section of the curriculum, which comes from "What it Looks like in the Classroom" section of Model Curriculum.

Summative Assessment 2:
Standards: 4-PS4-3, 3-5-ETS1-2, 3-5-ETS1-3
Type: Lab
Overview: Students will be challenged to design a way to use patterns to transfer information. Students will research other ways of communicating (drums, flashlight, morse code, box with rubber bands to pluck, musical patterns, string and cup phone, etc…). Students will present their object, and include information about how patterns are used to communicate. They can use pictures, videos, power points, audio recordings, as support. Students will classify and compare each others' objects.
Rubric: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)
Resources: Lab materials. "Learning Activities" section of the curriculum, which comes from "What it Looks like in the Classroom" section of Model Curriculum.

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
● Pre-assessments ● Labs ● Quizzes ● Project and problem-based learning activities ● Graphic organizers ● Short research projects ● Collaborative learning projects ● Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) ● Exit Tickets	● Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) ● Responses to inquiry-based questions ● Think-pair-share activities ● Student revising knowledge throughout the unit	● Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities

From the Model Curriculum Unit 8:

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.

Resources/Instructional Materials
(articles, novels, websites, books, magazines, art, media)

- **What Are Waves?**- (https://betterlesson.com/lesson/628342/what-are-waves)- This is a great introductory lesson on waves. It includes videos, explanations, and great hands on activities.
- **Waves Unit** (https://learning-in-action.williams.edu/opportunities/elementary-outreach/science-lessons/4th-grade-waves-unit/)- This site has an entire unit on waves.
- **Pop Bottle Waves and Hair Dryer Ripples**- (https://betterlesson.com/lesson/636706/pop-bottle-waves-hair-dryer-ripples)- Better Lesson- In this opening lesson, we explore what waves are all about as we observe, draw, and think about how waves are shaped and how they move and what creates them.
- **How Do Waves Move Objects? (** https://betterlesson.com/lesson/637060/how-do-waves-move-objects) - Better Lesson- Using what they have observed about water waves & questioning, students continue to develop the vocabulary and begin to understand how waves transfer energy.
- **Catch a Wave (** https://betterlesson.com/lesson/636938/catching-the-wave **) -** Better Lesson Lab- (Follow up to the "Pop Bottle Waves and Hair Dryer Ripples" Lab above). Students use their videos from Pop Bottle Waves & Hair Dryer Ripples to catch a wave, draw it, define its shape and find out what amplitude means.
- **Properties of Waves (** https://betterlesson.com/lesson/630477/properties-of-waves **)-** Better Lesson- In this direct instruction lesson, students draw sketches in their science notebooks in order to make sense of wave properties.
- **Morse Code** (https://betterlesson.com/lesson/644804/morse-code)- Better Lesson- Students learn that waves can be used to transfer information from one place to another.
- **Mini Lesson- A Big Splash! (** https://betterlesson.com/lesson/637618/mini-lesson-a-big-splash **) -** Better Lesson. (This lesson can possibly be used to assist in the Summative Assessment 1). Students drop several different sized objects into a bucket of water and observe what happens by measuring how long the wave continues after the displacement.

Technology Resources

- Mystery Science
- Kahoot!
- Brainpop
- Quizlet
- Better Lesson
- Google Classroom
- Youtube
- Discovery Education
- Zunal
- Scholastic

Accommodations & Modifications

for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml