South Harrison Township Elementary School District

Committed to Excellence

Course Name: Science	Grade Level(s): Fourth
BOE Adoption Date: October 2017	Revision Date(s):

ABSTRACT

Science in Grade 4 spans physical, earth, and life sciences. Students will explore how the weathering processes, Earth's systems, and plate tectonics has changed the face of the planet over time. They will develop examples of energy and show its conversion from one type to another. Students will use their knowledge of forces and motion, as well as the engineering design process, to develop and compare solutions to problems. Waves, and their importance in information transfer, will be explored. Students will then move specifically into light information to see how light information is acquired and perceived by the eye and the brain.

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Mission Statement

The primary goal of the South Harrison Township Elementary School District is to prepare each student with the real life skills needed to compete in a highly competitive global economy. This will be achieved by providing a comprehensive curriculum, the integration of technology, and the professional services of a competent and dedicated faculty, administration, and support staff.

Guiding this mission will be Federal mandates, including the Every Student Succeeds Act (ESSA), the New Jersey Student Learning Standards, and local initiatives addressing the individual needs of our students as determined by the Board of Education. The diverse resources of the school district, which includes a caring Home and School Association (HSA) and active adult community, contribute to a quality school system. They serve an integral role in supporting positive learning experiences that motivate, challenge and inspire children to learn.

Curriculum and Instruction Goals

Goal(s):

1. To ensure students are college and career ready upon graduation
2. To vertically and horizontally align curriculum K-12 to ensure successful transition of students at each grade level
3. To identify individual student strengths and weaknesses utilizing various assessment measures (formative, summative, alternative, etc.) so as to differentiate instruction while meeting the rigor of the applicable content standards
4. To improve student achievement as assessed through multiple measures including, but not limited to, state testing, local assessments, and intermediate benchmarking

Philosophy of the Shared Curriculum Service with Kingsway Regional School District

Together in its partnership with the South Harrison Township Elementary School District, the Kingsway Curriculum & Instruction Department is committed to providing all students grades K-12 with an engaging and quality curricular experience that aligns with the New Jersey Student Learning Standards (NJ SLS) for mathematics and English-Language Arts as well as the New Jersey Student Learning Standards (NJ SLS) for all other core disciplines. It is the goal of this shared service to provide students with curricular and educational experiences that allows them to succeed as they move on to the middle and high school level. Through this shared service, both horizontal and vertical alignment is stressed at and within each grade level with the aim of developing life-long learners who are college and career ready upon graduation from high school. Additionally, classroom instruction will be designed to meet the unique learning desires of all children and will be differentiated according to the needs of each learner. Whether through added support or enrichment activities, it is the role of the educator in the classroom to ensure students are reaching their highest level of social, emotional, and academic growth each school year. A combination of summative, formative, and performance-based assessments will be used to assess students' understanding and acquisition of necessary concepts and skills. Group work, projects, and a variety of co-curricular activities will make mathematics more meaningful and aid in the understanding of its application across all disciplines as well as in life.

How to Read this Document

This document contains a pacing guide and curriculum units. The pacing guides serve to deliver an estimated timeframe as to when noted skills and topics will be taught. The pacing of each course, however, will differ slightly depending upon the unique needs of each class. The curriculum units contain more detailed information as to the specific skills and concepts that are introduced as well as how students will be assessed. The terms and definitions below will assist the reader in better understanding the sections and components of this curriculum document.

Terms to Know

1. **Accommodation(s):** The term "accommodation" may be used to describe an *alteration* of environment, curriculum format, or equipment that allows an individual with a disability to gain access to content and/or complete assigned tasks. They allow students with disabilities to pursue a regular course of study. The term accommodation is often used interchangeable with the term modification. However, it is important to remember that modifications change or modify the intended learning goal while accommodations result in the same learning goal being expected but with added assistance in that achievement. Since accommodations do not alter what is being taught, instructors should be able to implement the same grading scale for students with disabilities as they do for students without disabilities.

2. **Differentiated Instruction:** Differentiation of instruction relies on the idea that instructional approaches should be tailored to each individual student's learning needs. It provides students an array of options during the learning process that allows them make sense of ideas as it relates to them. The integration of differentiated instructional techniques is a curriculum design approach to increase flexibility in teaching and decrease the barriers that frequently limit student access to materials and learning in classrooms. http://www.udlcenter.org/aboutudl

3. **Enduring Understanding:** Enduring understandings (aka big ideas) are statements of understanding that articulate deep conceptual understandings at the heart of each content area. Enduring understandings are noted in the alongside essential questions within each unit in this document. http://www.ascd.org

4. **Essential Question:** These are questions whose purpose is to stimulate thought, to provoke inquiry, and to spark more questions. They extend beyond a single lesson or unit. Essential questions are noted in the beginning of each unit in this document. http://www.ascd.org

5. **Formative Assessment(s):** Formative assessments monitor student learning to provide ongoing feedback that can be used by (1) instructors to improve teaching and (2) by students to improve their learning. Formative assessments help identify students' strengths and weaknesses and address problems immediately.

6. **Learning Activity(s):** Learning activities are those activities that take place in the classroom for which the teacher facilitates and the students participate in to ensure active engagement in the learning process. (Robert J. Marzano, *The Art and Science of Teaching*)

7. **Learning Assignment(s):** Learning assignments are those activities that take place independently by the student inside the classroom or outside the classroom (i.e. homework) to extend concepts and skills within a lesson. http://www.marzanocenter.com

8. **Learning Goal(s):** Learning goals are broad statements that note what students "should know" and/or "be able to do" as they progress through a unit. Learning goals correlate specifically to the NJSLS (New Jersey Student Learning Standards) are noted within each unit.

9. **Learning Objective(s):** Learning objectives are more specific skills and concepts that students must achieve as they progress towards the broader learning goal. These are included within each unit and are assessed frequently by the teacher to ensure students are progressing appropriately. http://www.marzanoresearch.com

10. **Model Assessment:** Within the model curriculum, model assessments are provided that included assessments that allow for measuring student proficiency of those target skills as the year of instruction progresses. http://www.state.nj.us/education/modelcurriculum/

11. **Model Curriculum:** The model curriculum has been provided by the state of New Jersey to provide a "model" for which districts can properly implement the NJSLS (New Jersey Student Learning Standards) by providing an example from which to work and/or a product for implementation.

12. **Modification(s):** The term "modification" may be used to describe a *change* in the curriculum. Modifications are typically made for students with disabilities who are unable to comprehend all of the content an instructor is teaching. The term modification is often used interchangeable with the term accommodations. However, it is important to remember that modifications change or modify the intended learning goal while accommodations result in the same learning goal being expected but with assistance in that achievement.

13. **Performance Assessment(s):** (aka alternative or authentic assessments) Performance assessments are a form of assessment that requires students to perform tasks that generate a more authentic evaluation of a student's knowledge, skills, and abilities. Performance assessments stress the application of knowledge and extend beyond traditional assessments (i.e. multiple-choice question, matching, true & false, etc.).

14. **Standard(s):** Academic standards, from which the curriculum is built, are statements that of what students "should know" or "be able to do" upon completion of a grade-level or course of study. Educational standards help teachers ensure their students have the skills and knowledge they need to be successful by providing clear goals for student learning. http://www.state.nj.us/njded/cccs/

    - **State:** The New Jersey Student Learning Standards (NJSLS) include Preschool Teaching and Learning Standards as well as K-12 standards for: *Visual and Performing Arts; Comprehensive Health and Physical Education; Science; Social Studies; World Languages; Technology; and 21st-Century Life and Careers.*

15. **Summative Assessment(s):** Summative assessments evaluate student learning at the end of an instructional time period by comparing it against some standard or benchmark. Information from summative assessments can be used formatively when students or faculty use it to guide their efforts and activities in subsequent courses.

16. **21st Century Skill(s):** These skills emphasis the growing need to focus on those skills that prepare students successfully by focusing on core subjects and 21st century themes; learning and innovation skills; information, media and technology skills; and life and career skills. These concepts are embedded in each unit of the curriculum. http://www.p21.org/our-work/p21-framework

Proficiencies and Pacing Guide:

Unit Title	Duration/Month(s)	Related Standards	Learning Goals	Crosscutting Concepts
Unit 1 How Earth has Changed throughout Time	8 Weeks	**ESS1.C: The History of Planet Earth** Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1) **ESS2.A: Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.E: Biology** Living things affect the physical characteristics of their regions. (4-ESS2-1)	***Students will…*** • Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. • Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	**Patterns** • Patterns can be used as evidence to support an explanation. (4-ESS1-1) **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1)
Unit 2 Plate Tectonics and Natural Hazards	9 Weeks	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** The locations of mountain ranges, deep ocean trenches,	***Students will…*** • Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	**Patterns** • Patterns can be used as evidence to support an explanation. (4-ESS2-2)

		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) **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	• Analyze and interpret data from maps to describe patterns of Earth's features. • 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.	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2) **Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

		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)		
Unit 3 Conservation of Energy	5 Weeks	**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) **PS3.B: Conservation of Energy and Energy Transfer** 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	***Students will…*** • Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. • Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	**Energy and Matter** • Energy can be transferred in various ways and between objects. ,(4-PS3-2) **Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

		sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)		
Unit 4 Forces and Motion *(with Engineering Design)*	6 Weeks	**PS3.A: Definitions of Energy** The faster a given object is moving; the more energy it possesses. (4-PS3-1) Energy can be moved from place to place by moving objects or through sound, light, or electric currents.(4-PS3-3) **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-3) **PS3.C: Relationship Between Energy and Forces** When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3- 3) **ESS3.A: Natural Resources** Energy and fuels that humans	***Students will…*** • Use evidence to construct an explanation relating the speed of an object to the energy of that object. • Ask questions and predict outcomes about the changes in energy that occur when objects collide. • Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. • 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 possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. • Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or	**Energy and Matter** • Energy can be transferred in various ways and between objects. (4-PS3- 1),(4-PS3-3) **Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1) • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

		use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1 **ETS1.A: Defining Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. *(secondary to 4-PS3-4)* **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-	prototype that can be improved.	

		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)		
Unit 5 Waves and Information	8 Weeks	**PS4.A: Wave Properties** Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (4-PS4-1) Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from	***Students will…*** • Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. • Generate and compare multiple solutions that use patterns to transfer information. • 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 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.	**Patterns** • Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) • Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) **Cause and Effect** • Cause and effect relationships are routinely identified. (4-PS4-2)

		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)*		

Unit 1: How Earth has Changed throughout Time	Recommended Duration: 8 Weeks
Unit Description: In 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.	

Essential Questions	Enduring Understandings
• *What do the shapes of landforms and rock formations tell us about the past?*	• *Patterns can be used as evidence to explain changes to the earth's landforms and rock formations.* • *Rock formations reveal changes over time due to earth forces.*

New Jersey Student Learning Standards		
By the end of the unit, the Student will be able to: **Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [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-ESS1-1) **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*] (4-ESS2-1)		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Identify the evidence that supports particular points in an explanation. (4-ESS1-1) **Planning and Carrying Out Investigations** • Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)	**ESS1.C: The History of Planet Earth** • Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1) **ESS2.A: Earth Materials and Systems** • Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4- ESS2-1) **ESS2.E: Biology** Living things affect the physical characteristics of their regions. (4-ESS2-1)	**Patterns** • Patterns can be used as evidence to support an explanation. (4-ESS1-1) **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. (4- ESS2-1)

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
• Rubrics • Learning Questions to guide unit progression • Observe and use patterns in the natural world as evidence. • Use observations *(firsthand or from media)* to describe	• Rubrics • Oral and Slate Assessments • Science Assessment Tasks	• Science Assessment Tasks • Science Investigations • Student Science notebooks • Student-designed models	**Possible NGSS Phenomena:** • *What can rock formations tell us about the past?* • *How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?*

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
patterns in the natural world in order to answer scientific questions. • Use observations to describe patterns in what plants need to survive. Examples of patterns could include:			

Possible Assessment Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **EXPRESS** their understanding and comprehension of the content/skills taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Modify assignments as needed (e.g., vary length, limit items) • Shorten assignments • Increase the amount of item allowed to complete assignments and tests • Limit amount of work required or length of tests • Hands-on-projects • Give in small groups ***Individualized per each student per IEP***	• Word/Picture Wall • L1 support • Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart • Native language support • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

Instructional Strategies
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Instructional Strategies
• Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable (NGSS) phenomena. • Structure the learning around explaining or solving a social or community-based issue.

Possible Instructional Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **ACCESS** the content/skills being taught?*

Special Education Students	English Language Learners (ELLs)	At-Risk Learners	Advanced Learners
• Read class materials orally • Provide small group instruction • Provide study outlines/guides • Prior notice of tests • Test study guide • Give tests in small groups **Individualized per each student per IEP**	• Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Native language support • Fact Family Triangles • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart, clock,) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

<table>
<tr><th>Interdisciplinary Connections (Applicable Standards)</th><th>Integration of Technology</th><th>21st Century Themes</th><th>21st Century Skills</th></tr>
<tr><td>NJSLS Literacy:
RI.4.1
RI.4.5
RI.4.10
W.4.2
W.4.5
L.4.1
SL.4.1
SL.4.2

NJSLS Mathematics:
4.CC.B.4
4.CC.B.5
4.MD.B.3

Mathematical Practices:
MP.1
MP.2
MP.3
MP.4
MP.6</td><td>8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge
• Students may use computers for reinforcement of skills during centers
• Interactive whiteboards may be used to display problems and/or interactive manipulatives
• Student use of iPads

8.2 All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.</td><td>Leadership and Responsibility- Acting responsibly with the interests of the larger community in mind.
• Students will participate in class activities and discussions appropriately
Collaboration- Demonstrating the ability to or kith diverse teams
• Students will learn to work with a partner on various math activities
Critical Thinking and Problem Solving- Exercising sound reasoning in understanding
• Students will develop problem solving skills and practice verbalizing their reasoning behind it</td><td>Leadership and Responsibility- Acting responsibly with the interests of the larger community in mind.
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Resources

Resources & Materials:

Suggested Literature:

- RAZ Kids (Leveled Texts)

Floods (V) | *Groundwater (V)* | *Earthquakes, Volcanoes, and Tsunamis (T, W)* | *Treasures from the Earth (S)*

Website/Media Links:

- Science Evidence Statements:
  - 4-ESS1-1
  - 4-ESS2-1
- Videos:
  - Bill Nye Video-Erosion: Bill Nye, "The Science Guy", presents a video describing the effects of weathering (wind, water, ice) on landforms.

Possible Investigations:

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.

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.

Students 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,

Resources

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.

- Plant Weathering Simulation: 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.
- Glaciers, Water, and Wind, Oh My! 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.
- Gary's Sand Journal: This book allows students to observe illustrations of magnified sand particles with guided dialogue from an earth scientist who discusses sand origins. This book can be used to introduce students to types of sand, explain how earth processes were responsible for their creation, and discuss the work of earth scientists. After reading this book, students may use it as a resource when examining their own sand samples. They could list properties, discuss sand origins, and illustrate samples in a science journal.
- Explaining Glaciers, Accurately: Fourth grade lessons on glacial erosion demonstrate and explain the manner in which glaciers erode the earth. The mechanisms of plucking and abrasion are discussed. Activities (either whole-class or small group) include a teacher creation of a glacier model (using dirt and rocks to simulate a mountain, ice cubes and a small amount of water for glacier), then teacher demonstration of glacier "plucking" earth as it travels in a simulation activity. Students then experiment with rock samples, wood, sandpaper, and ice as they rub materials against each other to explore how glacial striations form and abrade other surfaces. In each simulation, students are asked to predict what would happen when glacial

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model water freezes, as they draw before and after pictures of the model. Students are also asked to predict how glacial striations were formed as they view photos, then record results of their abrasive materials activity. • Coastal Erosion: This engineering design lesson focuses on the effects of erosion on Florida's coastline. 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.

Unit 2: Plate Tectonics and Natural Hazards	Recommended Duration: 9 Weeks
Unit Description: 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.	

Essential Questions	Enduring Understandings
• *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?*	• *Analysis of data can show scientists that there is a noticeable pattern of the natural events on the earth.*

New Jersey Student Learning Standards		
By the end of the unit, the Student will be able to: **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.*] (4-ESS3-2) **Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.] (4-ESS2-2) **Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.** (3-5-ETS1-2)		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** • The locations of mountain ranges, deep	**Patterns** • Patterns can be used as evidence to support an explanation. (4-

approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4- ESS3-2), (3-5-ETS1-2)	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) **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) • 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)	ESS2-2) **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2) **Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
• Rubrics • Learning Questions to guide unit progression • Observe and use patterns in the natural world as evidence. • Use observations *(firsthand or from media)* to describe patterns in the natural world in order to answer scientific questions. • Use observations to describe patterns in what plants need to survive. Examples of patterns could include:	• Rubrics • Oral and Slate Assessments • Science Assessment Tasks	• Science Assessment Tasks • Science Investigations • Student Science notebooks • Student-designed models	**Possible NGSS Phenomena:** • *Why do all of the earthquakes seem to be in California.*

Possible Assessment Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **EXPRESS** their understanding and comprehension of the content/skills taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Modify assignments as needed (e.g., vary length, limit items) • Shorten assignments • Increase the amount of item allowed to complete assignments and tests • Limit amount of work required or length of tests	• Word/Picture Wall • L1 support • Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart • Native language support • Choice questions • Teacher Modeling	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

• Hands-on-projects • Give in small groups ***Individualized per each student per IEP***	• Illustrations/diagrams/drawings • Small group		

Instructional Strategies
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable (NGSS) phenomena. • Structure the learning around explaining or solving a social or community-based issue.

Possible Instructional Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **ACCESS** the content/skills being taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Read class materials orally • Provide small group instruction • Provide study outlines/guides • Prior notice of tests • Test study guide	• Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Native language support • Fact Family Triangles • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart, clock,) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction

• Give tests in small groups **Individualized per each student per IEP**	• Small group		• Pairing direct instruction w/coaching to promote self-directed learning

Interdisciplinary Connections (Applicable Standards)	Integration of Technology	21st Century Themes	21st Century Skills
NJSLS Literacy: RI.4.1 RI.4.5 RI.4.10 W.4.2 W.4.5 L.4.1 SL.4.1 SL.4.2 ***NJSLS Mathematics:*** 4.CC.B.4 4.CC.B.5 4.MD.B.3 ***Mathematical Practices:*** MP.1 MP.2 MP.3 MP.4 MP.6	**8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge • Students may use computers for reinforcement of skills during centers • Interactive whiteboards may be used to display problems and/or interactive manipulatives • Student use of iPads **8.2** All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.	**Leadership and Responsibility**- Acting responsibly with the interests of the larger community in mind. • Students will participate in class activities and discussions appropriately **Collaboration**- Demonstrating the ability to or kith diverse teams • Students will learn to work with a partner on various math activities **Critical Thinking and Problem Solving**- Exercising sound reasoning in understanding • Students will develop problem solving skills and practice verbalizing their reasoning behind it	**Leadership and Responsibility**- Acting responsibly with the interests of the larger community in mind. • Students will participate in class activities and discussions appropriately **Collaboration**- Demonstrating the ability to or kith diverse teams • Students will learn to work with a partner on various math activities **Critical Thinking and Problem Solving**- Exercising sound reasoning in understanding • Students will develop problem solving skills and practice verbalizing their reasoning behind it

Resources

Suggested Reading (leveled texts):

- RAZ Kids (level)

Floods (V) *Earthquakes, Volcanoes, and Tsunamis (T, W)*

Getting the Right Angle on the Story: 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

Website/Media Links:

- Science Evidence Statements:
  - 4-ESS2-2
  - 4-ESS3-2
  - 3-5-ETS1-2

Possible Investigations:

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,

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communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. Students should routinely identify and test cause-and-effect relationships and use these relationships to explain the changes that they observe as they test design solutions.

At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. Students should routinely identify and test cause-and-effect relationships and use these relationships to explain the changes that they observe as they test design solutions.

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

- Engineering for the Three Little Pigs: 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 and test them in a variety of ways.
- Building for the Big One: This lesson plan details a Design Challenge in which students build and test structures while learning about the earthquakes that shake them. It is designed as a review or culmination of an Earthquake unit of study. The lesson plan allows teachers to connect back to previous lessons. Tectonic plate information is included in the lesson as a resource for the teacher.
- Earthquakes in the Classroom: 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. Background information for Teachers: https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_natdis/cub_natdis_lesson03.xml

Unit 3: Conservation of Energy	Recommended Duration: 5 Weeks
Unit Description: 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.	

Essential Questions	Enduring Understandings
• *Where do we get the energy we need for modern life?*	• *Energy can be transferred from place to place by a variety of ways.*

New Jersey Student Learning Standards		
By the end of the unit, the Student will be able to: **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] (4-PS3-2) **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.] (4-ESS3-1)		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or	**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) **PS3.B: Conservation of Energy and Energy Transfer** • 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	**Energy and Matter** • Energy can be transferred in various ways and between objects. ,(4-PS3-2) **Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

test a design solution. (4-PS3-2) **Obtaining, Evaluating, and Communicating Information** • Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. • Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)	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)	

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
• Rubrics • Learning Questions to guide unit progression • Observe and use patterns in the natural world as evidence. • Use observations *(firsthand or from media)* to describe patterns in the natural world in order to answer scientific questions. • Use observations to describe patterns in what plants need to survive. Examples of patterns could include:	• Rubrics • Oral and Slate Assessments • Science Assessment Tasks	• Science Assessment Tasks • Science Investigations • Student Science notebooks • Student-designed models	**Possible NGSS Phenomena:** ● *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?*

Possible Assessment Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **EXPRESS** their understanding and comprehension of the content/skills taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Modify assignments as needed (e.g., vary length, limit items) • Shorten assignments • Increase the amount of item allowed to complete assignments and tests • Limit amount of work required or length of tests • Hands-on-projects • Give in small groups ***Individualized per each student per IEP***	• Word/Picture Wall • L1 support • Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart • Native language support • Choice questions • Teacher Modeling • Illustrations/diagrams/drawin gs • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawin gs	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

Instructional Strategies
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable (NGSS) phenomena. • Structure the learning around explaining or solving a social or community-based issue.

Possible Instructional Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **ACCESS** the content/skills being taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Read class materials orally • Provide small group instruction • Provide study outlines/guides • Prior notice of tests • Test study guide • Give tests in small groups **Individualized per each student per IEP**	• Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Native language support • Fact Family Triangles • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart, clock,) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

Interdisciplinary Connections (Applicable Standards)	**Integration of Technology**	**21st Century Themes**	**21st Century Skills**
NJSLS Literacy: RI.4.1 RI.4.5 RI.4.10 W.4.2 W.4.5 L.4.1 SL.4.1 SL.4.2 ***NJSLS Mathematics:*** 4.CC.A.1 4.CC.A.2 4.CC.B.4 4.CC.B.5	**8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge • Students may use computers for reinforcement of skills during centers • Interactive whiteboards may be used to display problems and/or interactive manipulatives • Student use of iPads	**Leadership and Responsibility**- Acting responsibly with the interests of the larger community in mind. • Students will participate in class activities and discussions appropriately **Collaboration**- Demonstrating the ability to or kith diverse teams • Students will learn to work with a partner on various math activities **Critical Thinking and Problem Solving**- Exercising sound reasoning in understanding	**Leadership and Responsibility**- Acting responsibly with the interests of the larger community in mind. • Students will participate in class activities and discussions appropriately **Collaboration**- Demonstrating the ability to or kith diverse teams • Students will learn to work with a partner on various math activities **Critical Thinking and Problem Solving**- Exercising sound reasoning in understanding • Students will develop problem

Interdisciplinary Connections (Applicable Standards)	Integration of Technology	21st Century Themes	21st Century Skills
4.MD.B.3 ***Mathematical Practices:*** MP.1 MP.2 MP.3 MP.4 MP.6	**8.2** All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.	• Students will develop problem solving skills and practice verbalizing their reasoning behind it	solving skills and practice verbalizing their reasoning behind it

Resources
Suggested Literature: ● RAZ Kids (level) ○ *To Drill or Not to Drill (W)* ***Website/Media Links:*** ● Science Evidence Statements: ○ 4-PS3-2 ○ 4-ESS3-1 ● Switch Energy Project: The Educator Portal provides free access to a documentary, energy labs, videos, and study guides. ● 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: 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. ***Possible Investigations:*** 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.

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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”).

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 flowof 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.

Unit 4: Forces and Motion *(with Engineering Design)*	Recommended Duration: 6 Weeks

Unit Description: 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.

Essential Questions	Enduring Understandings
• *What is the relationship between the speed of an object and the energy of that object?* • *How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?*	• *Scientists can discover the relationship between the relative speed of an object and its energy.*

New Jersey Student Learning Standards

By the end of the unit, the Student will be able to:

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-PS3-1)

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-PS3-3)

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.*] (4-PS3-4)

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-ETS1-1)

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-ETS1-2)

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. (3-5-ETS1-3)

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) **Constructing Explanations and Designing Solutions** • Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. • Obtain and combine information from books and other reliable media to explain	**PS3.A: Definitions of Energy** • The faster a given object is moving, the more energy it possesses. (4-PS3-1) • Energy can be moved from place to place by moving objects or through sound, light, or electric currents.(4-PS3-3) **PS3.B: Conservation of Energy and Energy Transfer** • Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-3) **PS3.C: Relationship between Energy and Forces** • When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3- 3) **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	**Energy and Matter** • Energy can be transferred in various ways and between objects. (4-PS3- 1),(4-PS3-3) **Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1) • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

phenomena. (4-ESS3-1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)	resources are renewable over time, and others are not. (4-ESS3-1) **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 Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. *(secondary to 4-PS3-4)* **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.	

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
• Rubrics • Learning Questions to guide unit progression	• Rubrics • Oral and Slate Assessments • Science Assessment	• Science Assessment Tasks • Science Investigations • Student Science notebooks • Student-designed models	**Possible NGSS Phenomena:** • *In what ways does the energy change when objects collide?*

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
• Observe and use patterns in the natural world as evidence. • Use observations *(firsthand or from media)* to describe patterns in the natural world in order to answer scientific questions. • Use observations to describe patterns in what plants need to survive. Examples of patterns could include:	Tasks		• *Why do sports cars travel faster than minivans and trucks?*

Possible Assessment Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **EXPRESS** their understanding and comprehension of the content/skills taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Modify assignments as needed (e.g., vary length, limit items) • Shorten assignments • Increase the amount of item allowed to complete assignments and tests • Limit amount of work required or length of tests • Hands-on-projects • Give in small groups ***Individualized per each student per IEP***	• Word/Picture Wall • L1 support • Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Native language support • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

Instructional Strategies
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable (NGSS) phenomena. • Structure the learning around explaining or solving a social or community-based issue.

Possible Instructional Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **ACCESS** the content/skills being taught?*

Special Education Students	English Language Learners (ELLs)	At-Risk Learners	Advanced Learners
• Read class materials orally • Provide small group instruction • Provide study outlines/guides • Prior notice of tests • Test study guide • Give tests in small groups **Individualized per each student per IEP**	• Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Native language support • Fact Family Triangles • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart, clock,) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

Interdisciplinary Connections (Applicable Standards)	Integration of Technology	21st Century Themes	21st Century Skills
NJSLS Literacy: RI.4.1 RI.4.5 RI.4.10 W.4.2 W.4.5 L.4.1 SL.4.1 SL.4.2 ***NJSLS Mathematics:*** 4.CC.A.1 4.CC.A.2 4.CC.B.4 4.CC.B.5 4.MD.B.3 ***Mathematical Practices:*** MP.1 MP.2 MP.3 MP.4 MP.6	**8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge • Students may use computers for reinforcement of skills during centers • Interactive whiteboards may be used to display problems and/or interactive manipulatives • Student use of iPads **8.2** All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.	**Leadership and Responsibility**- Acting responsibly with the interests of the larger community in mind. • Students will participate in class activities and discussions appropriately **Collaboration**- Demonstrating the ability to or kith diverse teams • Students will learn to work with a partner on various math activities **Critical Thinking and Problem Solving**- Exercising sound reasoning in understanding • Students will develop problem solving skills and practice verbalizing their reasoning behind it	**Leadership and Responsibility**- Acting responsibly with the interests of the larger community in mind. • Students will participate in class activities and discussions appropriately **Collaboration**- Demonstrating the ability to or kith diverse teams • Students will learn to work with a partner on various math activities **Critical Thinking and Problem Solving**- Exercising sound reasoning in understanding • Students will develop problem solving skills and practice verbalizing their reasoning behind it

Resources
Possible Reading Connections: • RAZ Kids (level):   ○ *Energy Matters (O)*   *Riding on Roller Coasters (Q)*

Resources

Website/Media Links:

- Science Evidence Statements:
    - 4-PS3-1
    - 4-PS3-3
    - 3-5-ETS1-1
    - 3-5-ETS1-2
    - 3-5-ETS1-3

- Energy and Waves: An NGSS Unit that contains a large number of lesson and activities to engage students in the transfer of energy. Activities include creating catapults and solar ovens, marble collisions, the energy of the playground, and much more.
- Advanced High-Powered Rockets: 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
- Force and Motion: 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.
- Advanced High-Powered Rockets: 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.

- Energy Makes Things Happen: The Boy Who Harnessed the Wind: 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.
- Light Your Way: Using the engineering design process, students will be designing and building a lantern that they will hypothetically be taking with them as they explore a newly discovered cave. The criteria of the completed lantern will include: hands need to be free for climbing, the lantern must have an on/off switch, it must point ahead when they are walking so they can see in the dark, and the lantern must be able to stay lit for at least 15 minutes. The constraints of the activity will be limited materials with which to build. At the completion of the activity, the students will present their final lantern to the class explaining how they revised and adapted the lantern to meet the criteria of the project. Students will include in the presentation the sketch of the model they created prior to building showing the labeled circuit they designed.

Possible Investigations:

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

Resources

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.

Engineering Design:

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.

Resources
- 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 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.

Unit 5: Waves and Information	Recommended Duration: 8 Weeks
Unit Description: 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.	

Essential Questions	Enduring Understandings
• *How are waves used to transfer information?*	• *Waves are regular patterns of motion that can differ in amplitude and wavelength.*

New Jersey Student Learning Standards		
By the end of the unit, the Student will be able to: **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [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-PS4-1) **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.] (4-PS4-3) **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-ETS1-2) **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.** (3-5-ETS1-3)		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design	**PS4.A: Wave Properties** • Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the	**Patterns** • Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change

solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4- 1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4- PS4-3)	surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (4- PS4-1) • Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** • Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing the Design Solution** • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*	for natural phenomena. (4-PS4-1) • Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) **Cause and Effect** • Cause and effect relationships are routinely identified. (4-PS4-2)

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
• Rubrics • Learning Questions to guide unit progression • Observe and use patterns in the natural world as evidence. • Use observations *(firsthand or from media)* to describe	• Rubrics • Oral and Slate Assessments • Science Assessment Tasks	• Science Assessment Tasks • Science Investigations • Student Science notebooks • Student-designed models	**Possible NGSS Phenomena:** *Video: Slow motion water ripples* • *How can waves transfer information?* • *If a beach ball lands in the ocean, beyond the breaking waves, what will happen to it?* • *Which team can design a way to use patterns to communicate*

Formative Assessments	Summative Assessments	Performance Assessments	Major Activities/ Assignments
patterns in the natural world in order to answer scientific questions. • Use observations to describe patterns in what plants need to survive. Examples of patterns could include:			*with someone across the room?*

Possible Assessment Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **EXPRESS** their understanding and comprehension of the content/skills taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Modify assignments as needed (e.g., vary length, limit items) • Shorten assignments • Increase the amount of item allowed to complete assignments and tests • Limit amount of work required or length of tests • Hands-on-projects • Give in small groups ***Individualized per each student per IEP***	• Word/Picture Wall • L1 support • Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart • Native language support • Choice questions • Teacher Modeling • Illustrations/diagrams/drawin gs • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawin gs	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

Instructional Strategies
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

Instructional Strategies
• Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable (NGSS) phenomena. • Structure the learning around explaining or solving a social or community-based issue.

Possible Instructional Adjustments (Modifications /Accommodations/ Differentiation): *How will the teacher provide multiple means for the following student groups to **ACCESS** the content/skills being taught?*			
Special Education Students	**English Language Learners (ELLs)**	**At-Risk Learners**	**Advanced Learners**
• Read class materials orally • Provide small group instruction • Provide study outlines/guides • Prior notice of tests • Test study guide • Give tests in small groups **Individualized per each student per IEP**	• Word/Picture Wall • Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart) • Native language support • Fact Family Triangles • Choice questions • Teacher Modeling • Illustrations/diagrams/drawings • Small group	• Manipulatives (etc. Counters, Connecting Cubes, Base-Ten Blocks, Place Value T-Chart, clock,) • Teacher Modeling • Small group instruction • Extended time • Illustrations/diagrams/drawings	• Provide independent learning opportunities through learning contracts • Offer accelerated instruction • Computer-Assisted Instruction • Pairing direct instruction w/coaching to promote self-directed learning

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<tr>
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RI.4.1
RI.4.5
RI.4.10
W.4.2
W.4.5
L.4.1
SL.4.1
SL.4.2

NJSLS Mathematics:
4.CC.A.1
4.CC.A.2
4.CC.B.4
4.CC.B.5
4.MD.B.3

Mathematical Practices:
MP.1
MP.2
MP.3
MP.4
MP.6</td>
<td>8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge
• Students may use computers for reinforcement of skills during centers
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Resources

Website/Media Links:

- Science Evidence Statements:
    - 4-PS4-1
    - 4-PS1-3
    - 3-5-ETS1-2
    - 3-5-ETS1-3

Weather Science content for Kids and Teens: The National Weather Service has several education resources available at this website.

Resources
Energy in Waves Video:https://www.youtube.com/watch?v=tRzl7Z_VC08 ***Possible Investigations:*** 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 titled 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. ○ Energy and Waves: An NGSS Unit designed by McCracken County Schools in Kentucky contains a large number of lesson and activities to engage students in the transfer of energy. Activities include finding the amplitude of a wave, using Morse code, and much more. 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.

Resources

- 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.

- The Sound of Science: 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.