



Diocese of Alexandria ~ Catholic Schools

Where faith and knowledge grow



DIOCESE OF ALEXANDRIA

As the Diocese of Alexandria seeks to provide a comprehensive learning environment, we are charged to “Teach More” by showing how all learning flows from and relates to our Creator. In this way, we will give our teaching a deeper meaning and purpose than simply the content itself. With this as our goal, the Catholic Schools Office has intertwined our selected curricular standards with the Catholic Standards developed by the Cardinal Newman Society. Through the merging of these two curricula, English Language Arts, Mathematics, Science, and Social Studies, teachers will be provided a roadmap to guide student’s understanding and recognition of the relationship between learning and the connection to our God.

Thomas E. Roque, Sr.
Superintendent of Catholic Schools



DIOCESE OF ALEXANDRIA

Through comprehensive review of curricula from high performing districts throughout the United States in combination with parochial schools and Newman Cardinal Standards, the Curriculum Team for the Diocese of Alexandria has generated curricula for English Language Arts, Mathematics, Science, and Social Studies. The development of this framework is designed to guide the instructional path of teachers as they focus on the formation of their students in the areas of faith, academic excellence, responsible citizenry, and effective communication and collaboration. This process is a continuous improvement process with no defined beginning or end.

Barbara Forest, M.A..
Courtney Gistorb, M.Ed.

Denese Carter, M.Ed.
Tracy Bock, Ed.S.

Frameworks



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HOW TO USE

The frameworks are guides to instruction. The frameworks assist teachers in planning and pacing instruction. Specific dates or weeks that may be included in this document are for reference. Each school and teacher must consider the make-up of their students, focusing on the needs and strengths of each child when pacing and planning instruction.

The cycles for the year help pace instruction and ensure students have consistent coverage of the content. The duration (the suggested amount of time to spend on each cycle) does not accommodate for the scheduling of special events, inclement weather or school events. Teachers, with principal guidance, should adjust pacing as needed to accommodate for these events.

RESEARCH-BASED HIGH-YIELD PRACTICES FOR INSTRUCTION

These strategies have proven effective in affecting student learning and achievement gains. As you plan daily instruction, consider how and where to integrate these strategies into the instructional sequence. Effect size is in parentheses. Please refer to the works of John Hattie for a complete description of instructional effect size.

- Classroom Discussion/Discourse (.82)
- Teacher Clarity/making the learning visible with expectations for learning (.75)
- Reciprocal Teaching (.74)
- Feedback (.73)
- Metacognitive Strategies (.69)

Grade 4- Science



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Unit 1: WEATHERING AND EROSION

Instructional Days: 10 days

SUMMARY

What do the shapes of landforms and rock formations tell us about the past?

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

This unit is based on 4-ESS2-1 and 4-ESS1-1.

Student Learning Objectives

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)**

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)**

Unit Sequence

Part A: *How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?*

Concepts

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.
- Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
- Rainfall helps to shape the land and affects the types of living things found in a region.
- Living things affect the physical characteristics of their regions.

Formative Assessments

Students who understand the concepts can:

- Identify, test, and use cause-and-effect relationships in order to explain change.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- Make observations and/or measurements to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. *(Note: Assessment is limited to a single form of weathering or erosion.)* Examples of variables to test could include:
 - ✓ Angle of slope in the downhill movement of water
 - ✓ Amount of vegetation
 - ✓ Speed of the wind
 - ✓ Relative rate of deposition
 - ✓ Cycles of freezing and thawing of water
 - ✓ Cycles of heating and cooling
 - ✓ Volume of water flow

Unit Sequence

Part B: What can rock formations tell us about the past?

Concepts

- Science assumes consistent patterns in natural systems.
- Patterns can be used as evidence to support an explanation.
- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.
- The presence and location of certain fossil types indicate the order in which rock layers were formed.

Formative Assessments

Students who understand the concepts can:

- Support explanations using patterns as evidence.
- Identify the evidence that supports particular points in an explanation.
- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. *(Note: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.)* Examples of evidence from patterns could include
 - ✓ Rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time.
 - ✓ A canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.

Sample of Open Education Resources

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.

Bill Nye Video-Erosion: Bill Nye, "The Science Guy", presents a video describing the effects of weathering (wind, water, ice) on landforms. Bryce Canyon is used as an example of the ways in which freezing water, plant roots, and wind weather the earth's surface creating the means for erosion. Students in video simulate effects of weathering which can be duplicated in a classroom setting. Nye also emphasizes the passage of time in millions of years as he explains the slower erosive effects of certain types of weathering.

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 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. Students could benefit from the expertise of a mentoring geologist who shares illustrations and information with students and teachers.

Coastal Erosion: This engineering design lesson focuses on the effects of erosion on Florida's coastline. It is one lesson offered within a larger weathering and erosion unit. Students groups work to create and use a model able to slow erosion, without damaging the coastal ecosystem. Students are responsible for developing scale diagram of their coastline erosion solution before building and testing their models in a pan to simulate the coastline. Students then complete a redesign cycle. Similar lessons from the developer can be used in conjunction with this lesson to incorporate the effects of erosion on humans and wildlife.

Teacher Professional Learning Resources

[Teaching NGSS in Elementary School-Fourth Grade](#)

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

Visit the [resource collection](#).

[NSTA Web Seminar: Teaching NGSS in K-5: Constructing Explanations from Evidence](#)

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

To view related resources, visit the [resource collection](#).

[NGSS Core Ideas: Earth's Place in the Universe](#)

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

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

Appendix A: NGSS and Foundations for the Unit

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)*

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)*

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

| Science and Engineering Practices | Science and Engineering Practices | Science and Engineering Practices |
|--|--|--|
| <p><u>Planning and Carrying Out Investigations</u></p> <ul style="list-style-type: none"> Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) <p><u>Constructing Explanations and Designing Solutions</u></p> <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation. (4-ESS1-1) | <p><u>Planning and Carrying Out Investigations</u></p> <ul style="list-style-type: none"> Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) <p><u>Constructing Explanations and Designing Solutions</u></p> <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation. (4-ESS1-1) | <p><u>Planning and Carrying Out Investigations</u></p> <ul style="list-style-type: none"> Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) <p><u>Constructing Explanations and Designing Solutions</u></p> <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation. (4-ESS1-1) |

Grade 4 - Science



THE DIOCESE
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Unit 2: EARTH PROCESSES

Instructional Days: 10 Days

SUMMARY

Is it possible to engineer ways to protect humans from natural Earth?

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

This unit is based on 4-ESS2-2, 4-ESS3-2, 3-5-ETS1-2, and 3-5-ETS1-3.

Student Learning Objectives

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 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.]* [\(4-ESS3-2\)](#)

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. [\(3-5-ETS1-3\)](#)

| Unit Sequence | |
|--|--|
| <i>Part A: What can maps tell us about the features of the world?</i> | |
| Concepts | Formative Assessment |
| <ul style="list-style-type: none"> • Patterns can be used as evidence to support an explanation. • Maps can help locate the different land and water features of Earth. • The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. • Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. • Major mountain chains form inside continents or near their edges. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> • Support an explanation using patterns as evidence. • Analyze and interpret data to make sense of phenomena using logical reasoning. • Analyze and interpret data from maps to describe patterns of Earth’s features. Maps can include: <ul style="list-style-type: none"> ✓ Topographic maps of Earth’s land ✓ Topographic maps of Earth’s ocean floor ✓ Locations of mountains ✓ Locations of continental boundaries ✓ Locations of volcanoes and earthquakes |

| Unit Sequence | |
|--|--|
| <i>Part B: In what ways can the impacts of natural Earth processes on humans be reduced?</i> | |
| Concepts | Formative Assessment |
| <ul style="list-style-type: none"> • Cause-and-effect relationships are routinely identified, tested, and used to explain change. • Engineers improve existing technologies or develop new ones to increase benefits, decrease known risks, and meet societal demands. • A variety of hazards result from natural processes (e.g., earthquakes, floods, tsunamis, volcanic eruptions). • Humans cannot eliminate the hazards, but they can take steps to reduce their impacts. • Research on a problem should be carried out before beginning to design a solution. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> • Identify and test cause-and-effect relationships in order to explain change. • Generate multiple solutions to a problem and compare them based on how well they meet the criteria and constraints of the design solution. • Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans (<i>Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.</i>) Examples of solutions could include: <ul style="list-style-type: none"> ✓ Designing an earthquake-resistant building |

| | |
|---|--|
| <ul style="list-style-type: none"> • Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions to a problem is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. | <ul style="list-style-type: none"> ✓ Improving monitoring of volcanic activity. • Generate multiple possible solutions to a problem and compare them based on how well each is likely to meet the criteria and constraints of the problem. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. |
|---|--|

Sample of Open Education Resources

[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. The 'buildings' in this lesson are made of sand and glue, sand being a soil and glue being composed of different minerals. They then test them for strength (load bearing), and resistance to weathering. The students will then compare possible solutions and discuss how well each is likely to work while meeting the criteria and constraints of the problem. The students will be the engineers who figure out which materials are best for the buildings they are making, taking into consideration all the properties of materials that are discussed in the lesson.

[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. The Tech Museum of Innovation also suggests that the lesson might be used as a form of introduction to a unit about earthquakes. The lesson would then be used to determine students' prior knowledge to set the stage for the design challenge. This resource often mentions the effects of tectonic plates on earthquake location. Grade 4 curriculum does not include tectonic plates in their earth science curriculum. 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. The unit "URL" listed here is not being reviewed for the Performance Expectation listed. It is offered as a supplemental concept and lesson background aid for teachers.

https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_natdis/cub_natdis_lesson_03.xml

[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.

[DLESE Earth Science Literacy Maps](#) are a tool for teachers and students to find resources that relate to specific Earth science concepts. These maps illustrate connections between concepts and how they build upon one another across grade levels. Clicking on a concept within the maps will show DLESE resources related to the concept, as well as information about related [AAAS Project 2061 Benchmarks](#) and [National Science Education Standards](#).

Teacher Professional Learning Resources

[Using the NGSS Practices in the Elementary Grades](#)

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

[NGSS Core Ideas: Earth's Systems](#)

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

Dr. Wertheim began the presentation by introducing a framework for thinking about content related to Earth systems. She then showed learning progressions for each concept within the Earth's Systems disciplinary core idea and shared resources and strategies for addressing student preconceptions. Dr. Wertheim also talked about changes in the way NGSS addresses these ideas compared to previous common approaches. Participants had the opportunity to submit questions and share their feedback in the chat.

Appendix A: NGSS and Foundations for the Unit

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 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)

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)

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|--|---|---|
| <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2) <p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> 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) <p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, | <p>ESS2.B: Plate Tectonics and Large-Scale System Interactions</p> <ul style="list-style-type: none"> The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2) | <p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used as evidence to support an explanation. (4-ESS2-2) <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2) <p>Connections to Engineering, Technology, and Applications of Science</p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> |

using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

ESS3.B: Natural Hazards

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

ETS1.B: Designing Solutions to Engineering Problems

- Testing a solution involves investigating how well it performs under a range of likely conditions. *(secondary to 4-ESS3-2)*

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- 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)

- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

| | | |
|--|---|--|
| | <ul style="list-style-type: none"> • 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) <p>ETS1.C: Optimizing the Design Solution</p> <ul style="list-style-type: none"> • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3) | |
|--|---|--|

Grade 4 - Science



THE DIOCESE
of ALEXANDRIA

Unit 3: STRUCTURE AND FUNCTION

Instructional Days: 10 Days

SUMMARY

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

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

This unit is based on 4-LS1-1.

Student Learning Objectives

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

Unit Sequence

Part A: *How do internal and external parts of plants and animals help them to survive, grow, behave, and reproduce?*

| Concepts | Formative Assessment |
|--|--|
| <ul style="list-style-type: none">• A system can be described in terms of its components and their interactions.• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none">• Describe a system in terms of its components and their interactions.• Construct an argument with evidence, data, and/or a model.• Construct an argument to support the claim that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. <i>(Assessment is limited to macroscopic structures within plant and animal systems.)</i> Examples of structures could include:<ul style="list-style-type: none">✓ Thorns✓ Stems✓ Roots✓ Colored petals✓ Heart✓ Stomach✓ Lung✓ Brain✓ Skin |

Sample of Open Education Resources

[Animal Mouth Structures](#)

In this lesson, students gather evidence to understand features that enable them to meet their needs. In particular, they examine the mouth structures of different animals to help them understand how animals are adapted to obtain food in their environment.

Teacher Professional Learning Resources

[Connections Between Practices in NGSS, Common Core Math, and Common Core ELA](#)

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

[Engineering Design as a Core Idea](#)

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

Visit the resource [collection](#).

[NGSS Core Ideas: From Molecules to Organisms: Structures and Processes](#)

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

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

Visit the [resource collection](#).

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

Appendix A: NGSS and Foundations for the Unit

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

The performance expectations above were developed using the following elements from the NRC document
A Framework for K-12 Science Education:

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|--|
| <p><u>Engaging in Argument from Evidence</u></p> <ul style="list-style-type: none"> Construct an argument with evidence, data, and/or a model. (4-LS1-1) | <p><u>LS1.A: Structure and Function</u></p> <ul style="list-style-type: none"> Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) | <p><u>Systems and System Models</u></p> <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. (4-LS1-1) |

Grade 4 - Science



THE DIOCESE
of ALEXANDRIA

Unit 4: HOW ORGANISMS PROCESS INFORMATION

Instructional Days: 10 Days

SUMMARY

How do animals use their perceptions and memories to make decisions?

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

This unit is based on 4-LS1-2 and 4-PS4-2.

Student Learning Objectives

Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. *[Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.] (4-LS1-2)*

Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. *[Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.] (4-LS4-2)*

Unit Sequence

Part A: *How do animals receive and process different types of information from their environment in order to respond appropriately?*

| Concepts | Formative Assessment |
|---|--|
| <ul style="list-style-type: none">• A system can be described in terms of its components and its interactions.• Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.• Animals are able to use their perceptions and memories to guide their actions. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none">• Describe a system in terms of its components and their interactions.• Use a model to test interactions concerning the functioning of a natural system.• Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. <p>✓ Emphasis is on systems of information transfer.</p> <p>✓ <i>Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.</i></p> |

Unit Sequence

Part B: *What happens when light from an object enters the eye?*

| Concepts | Formative Assessment |
|---|--|
| <ul style="list-style-type: none">• Cause-and-effect relationships are routinely identified.• An object can be seen when light reflected from its surface enters the eyes. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none">• Identify cause-and-effect relationships.• Develop a model to describe phenomena.• Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. <i>(Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works).</i> |

Sample of Open Education Resources

[Pinhole Cameras and Eyes:](#)

In this activity, students make a pinhole camera and see images formed on an internal screen. They then use a lens to see how this affects the images. Students investigate variables in its construction, and explore how it models the human eye's ability to receive and process information.

[The Life of Environments](#)

This unit is designed to address the concept that organisms sense the environment in order to live. It is a far-ranging and comprehensive unit that is designed to address multiple NGSS performance expectations (4-LS1-2, 4LS1-2, 4-PS3-2, 4-PS4-2) in seven explorative sections, with an additional summative assessment step.

[Time to Think?](#)

This resource allows the user to accurately measure and experiment with human reaction time. An interactive program measures reaction times in milliseconds and compares them in different cases (from simply reacting to a visual cue to having to read and then make a decision before reacting). This site provides a wide range of information and activities on the connection between the brain and behavior. Note: Link is to main introductory page. Scroll down to find links for the activity and others pages that allow users to view the results of other participants and guidance for conducting further research.

[Catch It!](#)

This lesson sequence involves student investigation of human reaction time and variables that may affect it. An initial phase has students practice catching a dropped ruler and converting the distance it drops to the length of time it took to react. This provides an opportunity for data collection, graphing, and writing a conclusion. After this guided inquiry phase, students may conduct research on human senses and reaction time, or move on to designing their own investigations of the effects of variables of their choosing on their reaction times. *[NOTE - the link is to the CT Department of Education Science Curriculum page. Scroll to find that you can select Word, PDF, and Spanish versions of this resource under the title Grade 5 Embedded Task.]*

Teacher Professional Learning Resources

Teaching NGSS in K-5: Making Meaning through Discourse

The presenters were Carla Zembal-Saul, (Penn State University), Mary Starr, (Michigan Mathematics and Science Centers Network), and Kathy Renfrew (Vermont Agency of Education). After a brief introduction about the Next Generation Science Standards (NGSS), Zembal-Saul, Starr, and Renfrew gave context to the NGSS specifically for K-5 teachers, discussing three-dimensional learning, performance expectations, and background information on the NGSS framework for K-5. The presenters also gave a number of examples and tips on how to approach NGSS with students, and took participants' questions. The web seminar ended with the presentation of a number of recommended NSTA resources for participants to explore.

View the [resource collection](#).

Evaluating Resources for NGSS: The EQuIP Rubric

The presenters were Brian J. Reiser, Professor of Learning Sciences in the School of Education and Social Policy at Northwestern University, and Joe Krajcik, Director of the CREATE for STEM Institute.

After a brief overview of the NGSS, Brian Reiser, Professor of Learning Sciences, School of Education at Northwestern University and Joe Krajcik, Director of CREATE for STEM Institute of Michigan State University introduced the Educators Evaluating Quality Instructional Products (EQuIP) Rubric. The web seminar focused on how explaining how the EQuIP rubric can be used to evaluate curriculum materials, including individual lessons, to determine alignment of the lesson and/or materials with the NGSS. Three-dimensional learning was defined, highlighted and discussed in relation to the rubric and the NGSS. An emphasis was placed on how to achieve the conceptual shifts expectations of NGSS and three-dimensional learning using the rubric as a guide. Links to the lesson plans presented and hard copies of materials discussed, including the EQuIP rubric, were provided to participants. The web seminar concluded with an overview of NSTA resources on the NGSS available to teachers by Ted, and a Q & A with Brian Reiser and Joe Krajcik.

View the [resource collection](#).

NGSS Crosscutting Concepts: Systems and System Models

The presenter was Ramon Lopez from the University of Texas at Arlington. Dr. Lopez began the presentation by discussing the importance of systems and system models as a crosscutting concept. He talked about the key features of a system: boundaries, components, and flows and interactions. Dr. Lopez also described different types of system models, including conceptual, mathematical, physical, and computational models. Participants discussed their current classroom applications of systems and system models and brainstormed ways to address challenges associated with teaching this crosscutting concept.

[NGSS Core Ideas: From Molecules to Organisms: Structures and Processes](#)

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

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

Visit the [resource collection](#).

[NGSS Core Ideas: Energy](#)

The presenter was Jeff Nordine of the San Antonio Children's Museum. Ramon Lopez from the University of Texas at Arlington provided supporting remarks. The program featured strategies for teaching about physical science concepts that answer questions such as "How is energy transferred between objects or systems?" and "What is meant by conservation of energy?"

Dr. Nordine began the presentation by talking about the role of disciplinary core ideas within *NGSS* and the importance of energy as a core idea as well as a crosscutting concept. He then shared physicist Richard Feynman's definition of energy and related it to strategies for teaching about energy. Dr. Nordine talked about the elements of the energy core idea and discussed common student preconceptions.

Visit the [resource collection](#).

Appendix A: NGSS and Foundations for the Unit

Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. *[Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.] (4-LS1-2)*

Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. *[Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.] (4-LS4-2)*

The performance expectations above were developed using the following elements from the NRC document
[A Framework for K-12 Science Education:](#)

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|--|--|
| <p><u>Developing and Using Models</u></p> <ul style="list-style-type: none"> Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2) Develop a model to describe phenomena. (4-PS4-2) | <p><u>LS1.D: Information Processing</u></p> <ul style="list-style-type: none"> Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal’s brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2) <p><u>PS4.B: Electromagnetic Radiation</u></p> <ul style="list-style-type: none"> An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2) | <p><u>Systems and System Models</u></p> <ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2) <p><u>Cause and Effect</u></p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified. (4-PS4-2) |

Grade 4 - Science



THE DIOCESE
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Unit 5: TRANSFER OF ENERGY

Instructional Days: 15 Days

SUMMARY

Where do we get the energy we need for modern life?

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

This unit is based on 4-PS3-2 and 4-ESS3-1.

Student Learning Objectives

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](#))

| Unit Sequence | |
|---|---|
| <i>Part A: How does energy move?</i> | |
| Concepts | Formative Assessment |
| <ul style="list-style-type: none"> • Energy can be transferred in various ways and between objects. • Energy can be moved from place to place through sound, light, or electric currents. • Energy is present whenever there are moving objects, sound, light, or heat. • Light also transfers energy from place to place. • Energy can also be transferred from place to place by electric currents; the currents may have been produced to begin with by transforming the energy of motion into electrical energy. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> • Make observations to produce data that can serve as the basis for evidence for an explanation of a phenomenon or for a test of a design solution. • Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. |

| Unit Sequence | |
|--|---|
| <i>Part B: From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?</i> | |
| Concepts | Formative Assessment |
| <ul style="list-style-type: none"> • Cause-and-effect relationships are routinely identified and used to explain change. • Knowledge of relevant scientific concepts and research findings is important in engineering. • Over time, people's needs and wants change, as do their demands for new and improved technologies. • Energy and fuels that humans use are derived from natural sources. • The use of energy and fuels from natural sources affects the environment in multiple ways. • Some resources are renewable over time, and others are not. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> • Identify cause-and-effect relationships in order to explain change. • Obtain and combine information from books and other reliable media to explain phenomena. • Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. <ul style="list-style-type: none"> ✓ Examples of renewable energy resources could include: <ul style="list-style-type: none"> ○ Wind energy, ○ Water behind dams, and ○ Sunlight. |

| | |
|--|---|
| | <ul style="list-style-type: none">✓ Examples of nonrenewable energy resources are:<ul style="list-style-type: none">○ Fossil fuels,○ Fissile materials✓ Examples of environmental effects could include:<ul style="list-style-type: none">○ Loss of habitat due to dams○ Loss of habitat due to surface mining○ Air pollution from burning of fossil fuels. |
|--|---|

Sample of Open Education Resources

[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.

Teacher Professional Learning Resources

Assessment for the Next Generation Science Standards

The presenters were Joan Herman, Co-Director Emeritus of the National Center for Research on Evaluation, Standards, and Student Testing (CRESST) at UCLA; and Nancy Butler Songer, Professor of Science Education and Learning Technologies, University of Michigan.

Dr. Herman began the presentation by summarizing a report by the National Research Council on assessment for the Next Generation Science Standards (NGSS). She talked about the development of the report and shared key findings. Next, Dr. Songer discussed challenges for classroom implementation and provided examples of tasks that can be used with students to assess their proficiency on the NGSS performance expectations.

View the [resource collection](#).

NGSS Crosscutting Concepts: Patterns

The presenter was Kristin Gunckel from the University of Arizona. Dr. Gunckel began the presentation by discussing how patterns fit in with experiences and explanations to make up scientific inquiry. Then she talked about the role of patterns in NGSS and showed how the crosscutting concept of patterns progresses across grade bands. After participants shared their ideas about using patterns in their own classrooms, Dr. Gunckel shared instructional examples from the elementary, middle school, and high school levels.

NGSS Crosscutting Concepts: Structure and Function

The presenters were Cindy Hmelo-Silver and Rebecca Jordan from Rutgers University. Dr. Hmelo-Silver and Dr. Jordan began the presentation by discussing the role of the crosscutting concept of structure and function within NGSS. They then asked participants to think about the example of a sponge and discuss in the chat how a sponge's structure relates to its function. The presenters introduced the Structure-Behavior-Function (SBF) theory and talked about the importance of examining the relationships between mechanisms and structures. They also discussed the use of models to explore these concepts.

NGSS Core Ideas: Energy

The presenter was Jeff Nordine of the San Antonio Children's Museum. Ramon Lopez from the University of Texas at Arlington provided supporting remarks. The program featured strategies for teaching about physical science concepts that answer questions such as "How is energy transferred between objects or systems?" and "What is meant by conservation of energy?"

Dr. Nordine began the presentation by talking about the role of disciplinary core ideas within NGSS and the importance of energy as a core idea as well as a crosscutting concept. He then shared physicist Richard Feynman's definition of energy and related it to strategies for teaching about energy. Dr. Nordine talked about the elements of the energy core idea and discussed common student preconceptions.

Appendix A: NGSS and Foundations for the Unit

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)

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|--|--|--|
| <p><u>Planning and Carrying Out Investigations</u></p> <ul style="list-style-type: none"> • Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) <p><u>Obtaining, Evaluating, and Communicating Information</u></p> <ul style="list-style-type: none"> • Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1) | <p><u>PS3.A: Definitions of Energy</u></p> <ul style="list-style-type: none"> • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2) <p><u>PS3.B: Conservation of Energy and Energy Transfer</u></p> <ul style="list-style-type: none"> • Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) • Light also transfers energy from place to place. (4-PS3-2) • Energy can also be transferred from place to place by electric | <p><u>Energy and Matter</u></p> <ul style="list-style-type: none"> • Energy can be transferred in various ways and between objects. (4-PS3-2) <p><u>Cause and Effect</u></p> <ul style="list-style-type: none"> • Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1) <p><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p><u>Interdependence of Science, Engineering, and Technology</u></p> <ul style="list-style-type: none"> • Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1) |

| | | |
|--|---|---|
| | <p>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)</p> <p><u>ESS3.A: Natural Resources</u></p> <ul style="list-style-type: none">• 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) | <p><u>Influence of Engineering, Technology, and Science on Society and the Natural World</u></p> <ul style="list-style-type: none">• Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1) |
|--|---|---|

Grade 4 - Science



THE DIOCESE
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Unit 6: FORCE AND MOTION

Instructional Days: 15 Days

SUMMARY

What is the relationship between the speed of an object and the energy of that object?

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

This unit is based on 4-PS3-1 and 4-PS3-3.

Student Learning Objectives

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)

| Unit Sequence | |
|--|---|
| <i>Part A: What is the relationship between the speed of an object and its energy?</i> | |
| Concepts | Formative Assessment |
| <ul style="list-style-type: none"> • Energy can be transferred in various ways and between objects. • The faster a given object is moving, the more energy it possesses. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> • Describe various ways that energy can be transferred between objects. • Use evidence (e.g., measurements, observations, patterns) to construct an explanation. • Use evidence to construct an explanation relating the speed of an object to the energy of that object. <i>(Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.)</i> |

| Unit Sequence | |
|---|--|
| <i>Part B: In what ways does energy change when objects collide?</i> | |
| Concepts | Formative Assessment |
| <ul style="list-style-type: none"> • 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. • 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. • When objects collide, the contact forces transfer energy so as to change the objects' motions. | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> • Describe the various ways that energy can be transferred between objects. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Ask questions and predict outcomes about the changes in energy that occur when objects collide. Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. <i>(Assessment does not include quantitative measurements of energy.)</i> |

Sample of Open Education Resources

Spool Racers: This resource includes three parts: a video clip from the TV show, Zoom, to introduce the activity, an essay with background information about energy, and a set of printable instructions. Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of twists in the rubber band or changing other design features. These websites provide additional ideas for modifying the basic rubber band racer design: <http://www.scienceworld.ca/resources/activities/popcan-porsche> and <http://pbskids.org/designsquad/build/rubber-band-car/>.

Force and Motion: 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.

Teacher Professional Learning Resources

NGSS Crosscutting Concepts: Stability and Change

The presenter was Brett Moulding, director of the Partnership for Effective Science Teaching and Learning. Mr. Moulding began the web seminar by defining stability and change and discussing the inclusion of this concept in previous standards documents such as the National Science Education Standards (NSES). Participants brainstormed examples of science phenomena that can be explained by using the concept of stability and change. Some of their ideas included Earth's orbit around the Sun, carrying capacity of ecosystems, and replication of DNA. Mr. Moulding then discussed the role of stability and change within NGSS. Participants again shared their ideas in the chat, providing their thoughts about classroom implementation of this crosscutting concept.

NGSS Core Ideas: Energy

The presenter was Jeff Nordine of the San Antonio Children's Museum. Ramon Lopez from the University of Texas at Arlington provided supporting remarks. The program featured strategies for teaching about physical science concepts that answer questions such as "How is energy transferred between objects or systems?" and "What is meant by conservation of energy?"

Dr. Nordine began the presentation by talking about the role of disciplinary core ideas within NGSS and the importance of energy as a core idea as well as a crosscutting concept. He then shared physicist Richard Feynman's definition of energy and related it to strategies for teaching about energy. Dr. Nordine talked about the elements of the energy core idea and discussed common student preconceptions.

Visit the [resource collection](#).

Appendix A: NGSS and Foundations for the Unit

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)

The performance expectations above were developed using the following elements from the NRC document
A Framework for K-12 Science Education:

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|--|--|--|
| <p><u>Planning and Carrying Out Investigations</u></p> <ul style="list-style-type: none"> Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) <p><u>Asking Questions and Defining Problems</u></p> <ul style="list-style-type: none"> Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) <p><u>Constructing Explanations and Designing Solutions</u></p> <ul style="list-style-type: none"> Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1) | <p><u>PS3.A: Definitions of Energy</u></p> <ul style="list-style-type: none"> 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) <p><u>PS3.B: Conservation of Energy and Energy Transfer</u></p> <ul style="list-style-type: none"> 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) | <p><u>Energy and Matter</u></p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. (4-PS3-1) (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)

Grade 4 - Science



THE DIOCESE
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Unit 7: USING ENGINEERING DESIGN WITH FORCE AND MOTION SYSTEMS

Instructional Days: 15 Days

SUMMARY

How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

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

This unit is based on 4-PS3-4, 3-5-ETS1-1, 3-5-ETS1-2, and 3-5-ETS1-3.

Student Learning Objectives

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)**

Unit Sequence

Part A: How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

Concepts

- Science affects everyday life.
- Most scientists and engineers work in teams.
- Engineers improve existing technologies or develop new ones.
- People’s needs and wants change over time, as do their demands for new and improved technologies.
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
- Energy can be transferred in various ways and between objects.
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.
- The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.
- Possible solutions to a problem are limited by available materials and resources (constraints).
- The success of a designed solution is determined by considering the desired features of a solution (criteria).
- Different proposals for solutions can be

Formative Assessment

Students who understand the concepts are able to:

- Describe the various ways that energy can be transferred between objects.
- Apply scientific ideas to solve design problems.
- Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.)
- Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.
- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
- Generate and compare multiple possible

compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

- Research on a problem should be carried out before beginning to design a solution.
- Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

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

Sample of Open Education Resources

[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.

[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. This activity was one of numerous engineering lessons from the Virginia Children's Engineering Council geared towards Grades 1-5.

<http://www.childrensengineering.org/technology/designbriefs.php>.

Teacher Professional Learning Resources

[NGSS Appendix I](#) - Appendix I provides an explanation how engineering is treated in the NGSS. Engineering Design in the NGSS The Next Generation Science Standards (NGSS) represent a commitment to integrate engineering design into the structure of science education by raising engineering design to the same level as scientific inquiry when teaching science disciplines at all levels, from kindergarten to grade 12.

[NGSS Crosscutting Concepts: Energy and Matter—Flows, Cycles, and Conservation](#)

The presenters were Charles W. (Andy) Anderson and Joyce Parker from Michigan State University. Dr. Anderson and Dr. Parker began the web seminar by discussing the role of energy and matter as a crosscutting concept. They talked about energy and matter at different scales, from the atomic to the macroscopic. The presenters shared information about how students learn about this crosscutting concept and how to address preconceptions. They then described instructional strategies such as modeling that can help students better understand the flow of energy and matter.

[NGSS Crosscutting Concepts: Scale, Proportion, and Quantity](#)

The presenters were Amy Taylor and Kelly Riedinger from the University of North Carolina Wilmington. Dr. Taylor began the presentation by discussing the definition of scale. Next, Dr. Riedinger talked about the role of scale, proportion, and quantity in NGSS. Participants shared their own experiences teaching about scale in the classroom before the presenters described additional instructional strategies that can provide students with a real-world understanding of this crosscutting concept. Dr. Taylor and Dr. Riedinger showed examples of activities from elementary, middle, and high school. They shared video clips and other resources that can help educators build their capacity for teaching about scale.

Appendix A: NGSS and Foundations for the Unit

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)

The performance expectations above were developed using the following elements from the NRC document [*A Framework for K-12 Science Education:*](#)

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|--|---|--|
| <p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> Apply scientific ideas to solve design problems. (4-PS3-4) Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2) <p>Asking Questions and Defining Problems</p> <ul style="list-style-type: none"> Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes | <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4) <p>PS3.C: Relationship Between Energy and Forces</p> <ul style="list-style-type: none"> When objects collide, the contact forces transfer energy so as to change the objects' motions. (4- | <p>Energy and Matter</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. (4-PS3-4) <p><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> Engineers improve existing technologies or develop new ones. (4-PS3-4) |

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| <p>several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)</p> <p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> 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) | <p>PS3-3)</p> <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) <p>ETS1.A: Defining and Delimiting Engineering Problems</p> <ul style="list-style-type: none"> Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1) <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> 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 | <p>Connections to Nature of Science Science is a Human Endeavor</p> <ul style="list-style-type: none"> Most scientists and engineers work in teams. (4-PS3-4) Science affects everyday life. (4-PS3-4) <p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> 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) |
|---|---|--|

| | | |
|--|---|--|
| | <p>ideas can lead to improved designs. (3-5-ETS1-2)</p> <ul style="list-style-type: none">• 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) <p>ETS1.C: Optimizing the Design Solution</p> <ul style="list-style-type: none">• Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3) | |
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Grade 4 - Science



THE DIOCESE
of ALEXANDRIA

Unit 8: WAVES AND INFORMATION

Instructional Days: 20 Days

SUMMARY

How can we use waves to gather and transmit information?

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

Student Learning Objectives

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. [\(3-5-EST-1-2\)](#)

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. [\(3-5-ETS1-3\)](#)

Unit Sequence

Part A: *If a beach ball lands in the surf, beyond the breakers, what will happen to it?*

Concepts

- Science findings are based on recognizing patterns.
- Similarities and differences in patterns can be used to sort and classify natural phenomena.
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface.
- When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks)

Formative Assessments

Students who understand the concepts can:

- Sort and classify natural phenomena using similarities and differences in patterns.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
- Develop a model (e.g., diagram, analogy, or physical model) of waves to describe patterns in terms of amplitude and wavelength, and that waves can cause objects to move. *(Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength).*

Unit Sequence

Part B: Which team can design a way to use patterns to communicate with someone across the room?

Concepts

- Similarities and differences in patterns can be used to sort and classify designed products.
- Knowledge of relevant scientific concepts and research findings is important in engineering.
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—that is, convert it from digitized form to voice and vice versa.
- Different solutions need to be tested in order to determine which of them best solve the problem, given the criteria and the constraints.
- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

Formative Assessments

Students who understand the concepts can:

- Sort and classify designed products using similarities and differences in patterns.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Generate and compare multiple solutions that use patterns to transfer information. Examples of solutions could include:
 - ✓ Drums sending coded information through sound waves;
 - ✓ Using a grid of ones and zeroes representing black and white to send
 - ✓ information about a picture;
 - ✓ Using Morse code to send text.
- Plan and conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Sample of Open Education Resources

The “[What it Looks Like in the Classroom](#)” section of this document describes several student sense-making and engineering tasks.

The [Utah Education Network](#) has created several resources for fourth grade science teachers.

[Michigan NGSS Moodle](#): The purpose of this website to provide K-5 Science teachers with resources, lessons, and activities based on the NGSS which were created by teachers in our region.

Teacher Professional Learning Resources

NSTA Web Seminar: *NGSS Core Ideas: Waves and Their Applications in Technologies for Information Transfer, September 24, 2013*

Ramon Lopez from the University of Texas at Arlington is the presenter of this web seminar. The program featured strategies for teaching about physical science concepts that answer questions such as “How are waves used to transfer energy and information?” and “How are instruments that transmit and detect waves used to extend human senses?” The web seminar is available at:

http://learningcenter.nsta.org/resource/?id=10.2505/9/WSNGSS13_Oct22

NSTA Web Seminar: *Teaching NGSS in K-5: Making Meaning through Discourse*

Zemba-Saul, Starr, and Renfrew gave context to the NGSS specifically for K-5 teachers, discussing three-dimensional learning, performance expectations, and background information on the NGSS framework for K-5. The presenters also gave a number of examples and tips on how to approach NGSS with students, and took participants' questions. The web seminar ended with the presentation of a number of recommended NSTA resources for participants to explore. The web seminar is available at:

http://learningcenter.nsta.org/products/symposia_seminars/NGSS/webseminar50.aspx

NSTA Web Seminar: *Teaching NGSS in Elementary School—Fourth Grade*

The web seminar began with an introduction to NGSS, its framework for K-12 science education, and its cross-cutting concepts and core ideas by NSTA's Ted Willard. Mary Starr and Kathy Renfrew began with a look into disciplinary core ideas, using the example of energy, and how they apply to the fourth grade in terms of performance expectations and an approach to science and engineering practices. Kathy also brought a special guest with her, Tracy Lavalley, a teacher from Vermont featured in the web seminar's videos. Using two videos taken from Tracy's fourth grade classroom, lesson plan ideas and approaches were discussed and teachers were able to share their thoughts and approaches on the classroom activities. A number of NSTA Learning Center tools and resources were shared as well as a number of website links for further investigation. This web seminar is available at: https://learningcenter.nsta.org/products/symposia_seminars/NGSS/webseminar47.aspx.

Appendix A: NGSS and Foundations for the Unit

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. [\(3-5-EST-1-2\)](#)

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. [\(3-5-ETS-1-3\)](#)

The performance expectations above were developed using the following elements from the NRC document [A Framework for K-12 Science Education:](#)

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|--|---|---|
| <p>Developing and Using Models</p> <ul style="list-style-type: none"> Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) <p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> 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) Generate and compare multiple solutions to a problem based on how well they meet the criteria | <p>PS4.A: Wave Properties</p> <ul style="list-style-type: none"> 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. <i>(Note: This grade band endpoint was moved from K-2.)</i> (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) | <p>Patterns</p> <ul style="list-style-type: none"> 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) <p><i>Connections to Engineering, Technology, and Applications of Science</i></p> |

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| <p>and constraints of the design problem. (3-5-ETS1-2)</p> <p>Connections to Nature of Science</p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> • Science findings are based on recognizing patterns. (4-PS4-1) <p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> • 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) | <p>PS4.C: Information Technologies and Instrumentation</p> <ul style="list-style-type: none"> • 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) <p>ETS1.C: Optimizing The Design Solution</p> <ul style="list-style-type: none"> • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (<i>secondary to 4-PS4-3</i>) <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) • Tests are often designed to identify failure points or difficulties, which suggest the | <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> • Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3) <p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2) |
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| | | |
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| | <p>elements of the design that need to be improved. (3-5-ETS1-3)</p> <p>ETS1.C: Optimizing the Design Solution</p> <ul style="list-style-type: none">• Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3) | |
|--|---|--|