Science Grade 4

Length of Course: Term
Elective/Required: Required
Schools: Elementary
Eligibility: Grade 4
Credit Value: N/A
Date Approved: August 27, 2018
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4th Grade Science Curriculum Overview

The performance expectations in fourth grade help students formulate answers to questions such as:

- What are waves and what are some things they can do?
- How can water, ice, wind and vegetation change the land?
- What patterns of Earth’s features can be determined with the use of maps?
- How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals?
- What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?

Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the National Research Council Framework.

Earth and Space Science:

- Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move.
- Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans.
  - In order to describe patterns of Earth’s features, students analyze and interpret data from maps.

Physical Science:

- 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.
- Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions.
  - They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

Life Science:

- Fourth graders 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.

Crosscutting Concepts: The crosscutting concepts of patterns; cause and effect; energy and matter; systems and system models; 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.

Science & Engineering Practices: In the fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in:

- Asking questions;
- Developing and using models;
- Planning and carrying out investigations;
- Analyzing and interpreting data;
- Constructing explanations and designing solutions;
- Engaging in argument from evidence; and
- Obtaining, evaluating, and communicating information.

Students are expected to use these practices to demonstrate understanding of the core ideas.

Please click HERE to view the NJSLS-Science / NGSS for 4th Grade.
# 4th Grade Science Scope & Sequence (2018 - 2019)

## 1st Marking Period

**Earth & Space Science - Earth’s Systems: Processes That Shape The Earth**

### Unit 1: The History Of Planet Earth
*(Suggested Pacing: 25 Days)*

- **4-ESS1: Earth’s Place in the Universe**
  - Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (4-ESS1-1)

- **4-ESS2: Earth’s Systems**
  - Analyze and interpret data from maps to describe patterns of Earth’s features. (4-ESS2-2)

### Unit 2: Earth’s Systems
*(Suggested Pacing: 20 Days)*

- **4-ESS2: Earth’s Systems**
  - Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (4-ESS2-1)
  - Analyze and interpret data from maps to describe patterns of Earth’s features. (4-ESS2-2)

## 2nd Marking Period

**Earth & Space Science - Earth’s Systems: Processes That Shape The Earth**

### Unit 3: Natural Hazards
*(Suggested Pacing: 20 Days)*

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

- **3-5-ETS1: Engineering Design**
  - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. (3-5-ETS1-2)
  - 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)

**Physical Science - Waves: Waves & Information**

### Unit 4: Waves, Light, and Information
*(Suggested Pacing: 25 Days)*

- **4-PS4: Waves and Their Applications in Technologies for Information Transfer**
  - Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. (4-PS4-1)
  - Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2)
  - Generate and compare multiple solutions that use patterns to transfer information. (4-PS4-3)

- **3-5-ETS1: Engineering Design**
  - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)
  - 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)
## 3rd Marking Period
### Physical Science - Energy
#### Unit 5: Transdisciplinary Unit
(Suggested Pacing: 45 Days)

- **4-PS3: Energy**
  - Use evidence to construct an explanation relating the speed of an object to the energy of that object. (4-PS3-1).
  - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. (4-PS3-2)
  - Ask questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3)
  - Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (4-PS3-4)

- **4-ESS3: Earth and Human Activity**
  - Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (4-ESS3-1)

- **3-5-ETS1: Engineering Design**
  - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)
  - 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)

## 4th Marking Period
### Life Science - Structure, Function, and Information Processing
#### Unit 6: Molecules To Organisms
(Suggested Pacing: 45 Days)

- **4-LS1: From Molecules to Organisms: Structures and Processes**
  - Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. (4-LS1-1)
  - Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)

- **4-PS4 Waves and Their Applications in Technologies for Information Transfer**
  - Develop a model to describe that light reflecting from objects and entering the eyes allows objects to be seen. (4-PS4-2)

- **3-5-ETS1: Engineering Design**
  - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)
# Unit 1: The History of Planet Earth

<table>
<thead>
<tr>
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<th>4th</th>
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<tbody>
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**Domain:** Earth & Space Science

**Discovery TechBook Unit:** The Changing Earth

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<thead>
<tr>
<th>NJSLS - Science Performance Expectations:</th>
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| ● 4-ESS1: Earth's Place in the Universe  
  ○ Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (4-ESS1-1)  
| ● 4-ESS2: Earth's Systems  
  ○ Analyze and interpret data from maps to describe patterns of Earth's features. (4-ESS2-2) |

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<tr>
<th>NJSLS - Science Disciplinary Core Ideas:</th>
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</table>
| ● ESS1.C: The History of Planet Earth  
  ○ Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)  
| ● ESS2.B: Plate Tectonics and Large-Scale System Interactions  
  ○ The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2) |

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<th>NJSLS - Science CrossCutting Concepts:</th>
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| ● Patterns:  
  ○ Patterns can be used as evidence to support an explanation. (4-ESS1-1)  
| ● Cause and Effect:  
  ○ Cause and effect relationships are routinely identified, tested, and used to explain change (4-ESS2-1), (4-ESS3-2)  
| ● Scientific Knowledge Assumes an Order and Consistency in Natural Systems:  
  ○ Science assumes consistent patterns in natural systems. (4-ESS1-1) |

**NJ Social and Emotional Learning Competencies:**

https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf
### Essential Questions**

**The questions below are suggested EQs to springboard the unit. NGSS was composed for students to drive learning. Afford children the opportunity to ask the questions and define potential problems.**

- What can fossils tell us about Earth’s past?
- How and why is Earth constantly changing?

### Enduring Understandings & Practices

**By the end of this unit, students will understand:**

- Specific areas of the world are most likely to have strong earthquakes.
- Earth's crust is made up of tectonic plates that float on the mantle and interact at their boundaries.
- Many of the features on Earth’s surface exist at tectonic plate boundaries.
- Several major types of fossils exist.
- How different types of fossils form.
- The processes scientists use to date fossils with rocks.
- What fossils can tell us about the history of Earth and organisms that lived in the past.

**By the end of this unit, students will be able to:**

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)
- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)
- Identify the evidence that supports particular points in an explanation. (4-ESS1-1)
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

### Prior Learning:

**Grade 2:**

- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.
- Maps show where things are located. One can map the shapes and kinds of land and water in any area.
- Wind and water can change the shape of the land.

### Future Learning:

**Grade 5:**

- Nearly all of Earth’s available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

### Effective Implementation Strategies

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

**Assessment**

**End-of-Unit Performance Assessment:** Sediment Fossil Surprise - In this investigation, students will build a model of fossils found in sediment layers simulating what is left behind after many years of fossils being deposited. Students will discuss ways that their models are similar to and different from sediment layers found in nature. Students will then use their knowledge to write a story about what happened to an organism millions of years ago to create this particular fossil.

Please click [HERE](http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) to access our 2018 - 2019 K-5 Design Rubric.

**Suggested Hands-On Activities / Classroom Inquiries:**
Rock Layers Lab, Make a Fossil, Make Plate Boundaries, Where Plates Meet, Finding Plates

The following is a recommended progression to support the development of understandings necessary for the performance expectation(s).

Teachers should consider multiple data points when making instructional decisions.

(Please note: Though listed individually, some experiences may last longer than one class period. Time has been built into the pacing calendar to allot for this.)

<table>
<thead>
<tr>
<th>Experience</th>
<th>Objective/Desired Outcome</th>
<th>Classwork Resources</th>
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<tbody>
<tr>
<td>Student Questioning Opportunity</td>
<td>To spark curiosity and amplify engagement, students should formulate their own questions regarding the phenomena/topic of the unit. They should then be afforded an opportunity to investigate them (and others that emerge) throughout the unit in order to heighten authenticity and deepen their knowledge and understanding.</td>
<td>-KWHLAQ: Organizer</td>
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<td>-KWHLAQ: Google Slides</td>
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<td>-Science Questioning Graphic Organizer</td>
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<td>-QFT: Formulating effective questions</td>
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<td>-Ideas For Phenomena To Question:</td>
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<td>-NGSS Phenomena</td>
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<tr>
<td>#</td>
<td>Activity</td>
<td>Additional Resources</td>
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<tr>
<td>1</td>
<td>The layer of Earth that tells us the most about Earth’s history is the crust.</td>
<td>-Google Slides Unit Presentation</td>
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<tr>
<td>2</td>
<td>Understand rocks form in layers.</td>
<td>-Google Slides Unit Presentation</td>
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<td>3</td>
<td>Explain how different layers of rock form.</td>
<td>-Google Slides Unit Presentation</td>
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<td>-NJCTL: Rock Layers Lab</td>
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<td>4</td>
<td>Explain what we can learn from fossils.</td>
<td>-DE: Engage Fossils</td>
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<td>-Defined STEM: Dinosaur Hunter: Fossils and the Past</td>
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<td>5</td>
<td>Describe different types of fossils and how they form.</td>
<td>-DE: Explore</td>
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<td>-Google Slides Unit Presentation</td>
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<td>6</td>
<td>Describe different types of fossils and how they form.</td>
<td>-DE: Explore</td>
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<td>-DE: No Bones About It</td>
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<td>7</td>
<td>Simulate the creation of a fossil.</td>
<td>-DE: Hands on Activity-Make a Fossil</td>
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<td>8</td>
<td>Describe and explain different plate tectonics.</td>
<td>-DE: Engage</td>
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<td>-Google Slides Unit Presentation</td>
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<td>-DE: Hands on activity- Plate Boundaries and Earthquakes</td>
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<td>9</td>
<td>Create and describe plate tectonic boundaries.</td>
<td>-NJCTL: Where Plates Meet Activity</td>
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<td>10</td>
<td>Determine the causes of different land formations.</td>
<td>-DE: Engage</td>
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<td>-DE: Video “Why Land Goes Up and Down”</td>
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<td>-Google Slides Unit Presentation</td>
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<td>-DE: Landform Exploration</td>
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<td>-Mystery Science: Could a Volcano Pop Up in your Backyard?</td>
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</table>
| **11** | **Describe the patterns of Earth's features.** | -Google Slides Unit Presentation  
-**Mystery Science:** Will a Mountain Last Forever? |
| **12** | **Describe the patterns of Earth's features.** | -**NJCTL:** Finding Plates |
| **13** | **End-of-Unit Performance Assessment** | -**Sediment Fossil Surprise** - In this investigation, students will build a model of fossils found in sediment layers simulating what is left behind after many years of fossils being deposited. Students will discuss ways that their models are similar to and different from sediment layers found in nature. Students will then use their knowledge to write a story about what happened to an organism millions of years ago to create this particular fossil. |

**Additional Classroom Resources**

- **Study Jams: Fossils**
- **Earth Rocks!** The purpose of this lesson is to introduce students to the basic elements of our Earth's crust: rocks, soils and minerals. They learn how we categorize rocks, soils and minerals and how they are literally the foundation for our civilization. Students also explore how engineers use rocks, soils and minerals to create the buildings, roads, vehicles, electronics, chemicals, and other objects we use to enhance our lives.  
- **Our Big Blue Marble:** Students are introduced to the fabulous planet on which they live. Even though we spend our entire lives on Earth, we still do not always understand how it fits into the rest of the solar system. Students learn about the Earth's position in the solar system and what makes it unique. They learn how engineers study human interactions with the Earth and design technologies and systems to monitor, use and care for our planet's resources wisely to preserve life on Earth.  
- **Carve That Mountain:** Students consider the Earth's major types of landforms such as mountains, rivers, plains, hills, canyons, oceans and plateaus. Student teams build three-dimensional models of landscapes, depicting several of these landforms. Once the models are built, they act as civil and transportation engineers to design and build roads through the landscapes they have created. The worksheet is provided in English and Spanish.  

**Teacher Professional Learning Resources**

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

**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.

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

**Bozeman Science:** A collection of videos covering all NGSS Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas.
# Unit 2: Earth Systems: Processes that Shape the Earth

<table>
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<th>Grade:</th>
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<tbody>
<tr>
<td>Suggested Pacing:</td>
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</tr>
<tr>
<td>Domain:</td>
<td>Earth &amp; Space Science</td>
</tr>
<tr>
<td>TechBook Unit:</td>
<td>The Changing Earth</td>
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</tbody>
</table>

**NJSLS - Science Performance Expectations:**

- **4-ESS2: Earth’s Systems**
  - Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (4-ESS2-1)
  - Analyze and interpret data from maps to describe patterns of Earth’s features. (4-ESS2-2)

**NJSLS - Science Disciplinary Core Ideas:**

- **ESS2.A: Earth Materials and Systems**
  - Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)
- **ESS2.E: Biogeology**
  - Living things affect the physical characteristics of their regions. (4-ESS2-1)

**NJSLS - Science CrossCutting Concepts:**

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

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

- **Scientific Knowledge Assumes an Order and Consistency in Natural Systems:**
  - Science assumes consistent patterns in natural systems. (4-ESS1-1)

**NJ Social and Emotional Learning Competencies:**

[https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf](https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf)

**Essential Questions**

**The questions below are suggested EQs to springboard the unit. NGSS was composed for students to drive learning. Afford children the opportunity to ask the questions and define potential problems.**

- How and why is Earth constantly changing?
- How do Earth’s surface processes and human activities affect each other?
## Enduring Understandings & Practices

<table>
<thead>
<tr>
<th>By the end of this unit, students will understand:</th>
<th>By the end of this unit, students will be able to:</th>
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<tbody>
<tr>
<td>● Earth has four systems the work together.</td>
<td>● Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)</td>
</tr>
<tr>
<td>● Earth’s four systems are the atmosphere, biosphere, geosphere, and hydrosphere.</td>
<td>● Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)</td>
</tr>
<tr>
<td>● Weathering is the break down or dissolving of rocks on Earth’s surface.</td>
<td>● Identify the evidence that supports particular points in an explanation. (4-ESS1-1)</td>
</tr>
<tr>
<td>● Erosion is the movement of broken down rocks.</td>
<td>● 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)</td>
</tr>
<tr>
<td>● All living things affect the physical characteristics of their environment.</td>
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## Prior Learning:

### Grade 2:
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.
- Maps show where things are located. One can map the shapes and kinds of land and water in any area.
- Wind and water can change the shape of the land.

## Future Learning:

### Grade 5:
- Nearly all of Earth’s available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

## Effective Implementation Strategies

- Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multi-modal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#VXmoXcD_UA).
Assessment

**End-of-Unit Performance Assessment:** Hands-On Inquiry: *The Case of the Disappearing Soccer Field* In this activity, students investigate the role of soil type, slope, and water flow on soil erosion of a model hillside in order to find out why one soccer field is affected by erosion more than another.

Please click [HERE](#) to access our 2018 - 2019 K-5 Design Rubric.

**Suggested Hands-On Activities / Classroom Inquiries:**
Modeling Chemical Weathering Activity, Virtual Lab: Here Today, Gone Tomorrow, Earth Systems Walk Activity

The following is a recommended progression to support the development of understandings necessary for the performance expectation(s).

Teachers should consider multiple data points when making instructional decisions.

*(Please note: Though listed individually, some experiences may last longer than one class period. Time has been built into the pacing calendar to allot for this.)*

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| Student Questioning Opportunity | To spark curiosity and amplify engagement, students should formulate their own questions regarding the phenomena/topic of the unit. They should then be afforded an opportunity to investigate them (and others that emerge) throughout the unit in order to heighten authenticity and deepen their knowledge and understanding. Teachers may use these questions as a pre-assessment and as a means to guide future learning experiences. | -KWHLAQ: Organizer  
-KWHLAQ: Google Slides  
-Science Questioning Graphic Organizer  
-QFT: Formulating effective questions  
-Ideas For Phenomena To Question:  
-NGSS Phenomena  
-#ProjectPhenomena |
| 1 | Define and identify Earth’s four systems | -Google Slides Unit Presentation |
| 2 | Describe the processes and identify examples of weathering and erosion | -DE Engage: Erosion and Deposition  
-DE Weathering and Erosion Video  
-Defined STEM: Erosion Management Specialist |
| 3 | Identify causes of mechanical weathering | -Google Slides Unit Presentation  
-DE- Forces That Shape The Earth Exploration |
|   | Identify causes of chemical weathering | -Google Slides Unit Presentation  
|   |   | -DE: Video on Chemical Weathering  
| 5 | Explain how chemical reactions in these activities break things down – weathers them – but in a different way than mechanical weathering does. | -NJCTL: Modeling Chemical Weathering Activity  
| 6 | Identify causes of erosion | -Google Slides Unit Presentation  
|   |   | -Crash Course Video on Erosion  
|   |   | -Hands on exploration- Erosion  
| 7 | Explain how water and wind can cause erosion and/or deposition | -DE Erosion and Deposition Exploration  
| 8 | Identify ways to decrease soil erosion | -DE Soil Assignment  
|   |   | -DE Erosion - Here Today, Gone Tomorrow Virtual Lab  
| 9 | Describe how all living things affect the physical characteristics of their environment | -Google Slides Unit Presentation  
| 10 | Observe evidence of biogeology in our environment | -NJCTL: Earth Systems Walk Activity  
|   |   | -Defined STEM: Student Conservation: Rain Gardens  
| 11 | Observe and identify how erosion leads to landslides | -Mystery Science: How could you Survive a Landslide?  
|   |   | -Defined STEM: Landscape Architect  
| 12 | End-of-Unit Performance Assessment | -Hands-On Inquiry: The Case of the Disappearing Soccer Field In this activity, students investigate the role of soil type, slope, and water flow on soil erosion of a model hillside in order to find out why one soccer field is affected by erosion more than another.  
|   |   | The Case of the Disappearing Soccer Field: Teacher's Guide  
| Improve | Students are given time to revise their projects/solutions and finalize their plans based on the feedback of their peers and teacher(s). | -Individuals or groups modify their designs to incorporate feedback.  


<table>
<thead>
<tr>
<th>Additional Classroom Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Jams: Erosion</strong></td>
</tr>
<tr>
<td><strong>Glaciers, Water, and Wind, Oh My!</strong> 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.</td>
</tr>
<tr>
<td><strong>The Earth is a Changin’</strong>: Students are introduced to the primary types of erosion—by chemical, water, wind, glacier and temperature. They learn examples of each erosion type and discuss how erosion changes the surface of the Earth. Students also learn why engineers need to be aware of the different types of erosion in order to protect structures and landmarks from the damaging effects erosion can cause.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Teacher Professional Learning Resources</th>
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<tbody>
<tr>
<td><strong>NGSS Core Ideas: Earth’s Systems</strong></td>
</tr>
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<td>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 &quot;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.</td>
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<tr>
<th>Bozeman Science:</th>
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## Unit 3: Natural Hazards

<table>
<thead>
<tr>
<th>Grade:</th>
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<tbody>
<tr>
<td>Suggested Pacing:</td>
<td>20 days</td>
</tr>
<tr>
<td>Domain:</td>
<td>Earth &amp; Space Science</td>
</tr>
<tr>
<td>Discovery TechBook Unit:</td>
<td>The Changing Earth</td>
</tr>
</tbody>
</table>

### NJSLS - Science Performance Expectations:

- **4-ESS3 Earth and Human Activity**
  - Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. (4-ESS3-2)
- **3-5-ETS1: Engineering Design**
  - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. (3-5-ETS1-2)
  - 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)

### NJSLS - Science Disciplinary Core Ideas:

- **ESS3.B: Natural Hazards**
  - A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2)
- **ETS1.B: Designing Solutions To Engineering Problems**
  - Testing a solution involves how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)
- **ETS -2: Developing Possible Solutions**
  - 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.
- **ETS-3: Planning and Carrying out Investigations**
  - 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

### NJSLS - Science CrossCutting Concepts:

- **Patterns:**
  - Patterns can be used as evidence to support an explanation. (4-ESS1-1), (4-ESS2-2)
- **Cause and Effect:**
  - Cause and effect relationships are routinely identified, tested, and used to explain change (4-ESS2-1), (4-ESS3-2)
- **Scientific Knowledge Assumes an Order and Consistency in Natural Systems:**
  - Science assumes consistent patterns in natural systems. (4-ESS1-1)

### NJSLS - Technology:

- **8.2 Technology Education, Engineering, Design and Computational Thinking - Programming**
  - Identify and collect information about a problem that can be solved by technology, generate ideas to solve the problem, and identify constraints and trade-offs to be considered. (8.2.5.D.1)
  - Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process to evaluate potential solutions. (8.2.5.D.2)

### NJ Social and Emotional Learning Competencies:

[https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf](https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf)
## Essential Questions**

**The questions below are suggested EQs to springboard the unit. NGSS was composed for students to drive learning. Afford children the opportunity to ask the questions and define potential problems.**

- How do natural hazards affect individuals and societies?
- How do Earth’s surface processes and human activities affect each other?

## Enduring Understandings & Practices

By the end of this unit, students will understand:

- The causes of earthquakes and tsunamis.
- The manner in which volcanoes erupt.
- The classification of volcanoes.
- Natural hazards cannot be prevented but their damage can be minimized.
- How scientists monitor and/or predict earthquakes, volcanoes and tsunamis.

By the end of this unit, students will be able to:

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)
- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)
- Identify the evidence that supports particular points in an explanation. (4-ESS1-1)
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

## Prior Learning

### Grade 2:

- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that communities can prepare for and respond to these events.

## Future Learning

### Grade 5:

- Nearly all of Earth’s available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth’s resources and environments.

### Grade 7:

- All Earth processes are the result of energy flowing and matter cycling within and among the planet’s systems. This energy is derived from the sun and Earth’s hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth’s materials and living organisms.
- The planet’s systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth’s history and will determine its future.
- Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

**Effective Implementation Strategies**

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

**Assessment**

**End-of-Unit Performance Assessment:** Designing an Earthquake Proof Resort: In this activity, students design and build a model resort that can withstand an earthquake. They use a shake table to test how well the model would hold up during an earthquake. Students will also equip their resort with bedroom/bathroom necessities, furniture, and decoration in order to prepare for the arrival of their future guests.

*Click [HERE](#) to access our 2018 - 2019 Integrated Math/Science Rubric*

*Please note: Students will receive a separate math and science grade for this PBA based on the rubrics. For scoring information, please click [HERE](#).*

**Suggested Hands-On Activities / Classroom Inquiries:** Seismograph Design Challenge, Tsunami Speed Lab, Building an Earthquake Proof Resort

The following is a recommended progression to support the development of understandings necessary for the performance expectation(s). Teachers should consider multiple data points when making instructional decisions.

*(Please note: Though listed individually, some experiences may last longer than one class period. Time has been built into the pacing calendar to allot for this.)*
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-KWHLAQ: Google Slides  
-Science Questioning Graphic Organizer  
-QFT: Formulating effective questions  
-Ideas For Phenomena To Question:  
-NGSS Phenomena  
#ProjectPhenomena |
| 1 | Identify Natural Hazards | -Google Slides Unit Presentation  
-NJCTL: Natural Hazards Classwork  
-Defined STEM: The Dust Bowl and Human Migration |
| 2 | Design an Earthquake proof house | Design challenge Pre-Assessment: (Optional) Complete Introduction, Part 1 and Part 2 for the Hands on Lab (explanation) Design Challenge (Hand-out for Students) Part 1 Only Students will revise, redesign and test their resorts again at the end of the unit. Students should keep their notes and sketches from this experience. (Design Challenge Teacher’s Notes)  
-Alternative Design for a Shake Table  
Keep the Shake table for the end of the Unit |
| 3 | Describe the causes of and damage from earthquakes. | -DE Engage: Activate Prior Knowledge and KWL  
-DE: Getting to know Earthquakes (Reading Passage) |
| 4 | Describe the causes of earthquakes | -Google Slides Unit Presentation  
-Review types of plate boundaries from Unit 1, Experience 8 (Repeat activity if necessary)  
-DE Exploration: Earthquakes with Student Guide  
-Use Teacher Guide for Discussion Questions |
| 5 | Understand how scientists monitor and predict earthquakes | -NJCTL: Seismograph Design Challenge  
-Defined STEM: Emergency Services Director: Earthquakes |
| 6 | Explain the causes of tsunamis and describe how damage can be minimized | -How Tsunamis are Formed Video  
-Tsunami Speed Lab (Tsunami Speed Lab Teacher’s Notes)  
-Google Slides Unit Presentation |
| 7 | Describe Volcanoes and the way they erupt | -DE Engage  
- Google Slides Unit Presentation  
- Mystery Science: Why do Some Volcanoes Explode?  
- Defined STEM: Museum Exhibit: Volcanoes And Humans |
|---|---|---|
| 8 | Understand how scientists monitor and predict volcanic eruptions | - Google Slides Unit Presentation  
- NJCTL: Volcanoes - Classwork/Homework |
| 9 | End-of-Unit Performance Assessment:  
Design an Earthquake proof house | - Google Slides Unit Presentation  
- Design challenge: Complete Part 3 for the Hands on Lab  
**Students will revise, redesign and test their resorts from the beginning of the unit. A math component has been integrated for summative assessment.**  
Design Challenge (Hand out for Students) |

**Additional Classroom Resources**

**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.

**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.

**Study Jams: Earthquakes**
### Teacher Professional Learning Resources

**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.

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

**Bozeman Science:** A collection of videos covering all NGSS Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas.
### Unit 4: Waves, Light, & Information

<table>
<thead>
<tr>
<th>Grade:</th>
<th>4th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suggested Pacing:</td>
<td>25 days</td>
</tr>
<tr>
<td>Domain:</td>
<td>Physical Science</td>
</tr>
<tr>
<td>Discovery TechBook Unit:</td>
<td>Energy Transfer in Waves</td>
</tr>
</tbody>
</table>

#### NJSLS - Science Performance Expectations:

- **4-PS4: Waves and Their Applications in Technologies for Information Transfer**
  - Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. (4-PS4-1)
  - Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2)
  - Generate and compare multiple solutions that use patterns to transfer information. (4-PS4-3)
- **3-5-ETS1: Engineering Design**
  - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)
  - 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)

#### NJSLS - Science Disciplinary Core Ideas:

- **PS4.A: Wave Properties**
  - Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets the beach. *(Note: This grade band endpoint was moved from K–2).* (4-PS4-1)
  - Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)
- **PS4.B: Electromagnetic Radiation**
  - An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)
- **PS4.C: Information Technologies and Instrumentation**
  - Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)
- **ETS1.C: Optimizing The Design Solution**
  - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)

#### NJSLS - Science CrossCutting Concepts:

- **Patterns:**
  - Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)
  - Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)
- **Cause and Effect:**
  - Cause and effect relationships are routinely identified. (4-PS4-2)
**Interdependence of Science, Engineering, and Technology:**
- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

NJ Social and Emotional Learning Competencies:
https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf

### Essential Questions**
**The questions below are suggested EQs to springboard the unit. NGSS was composed for students to drive learning. Afford children the opportunity to ask the questions and define potential problems.**

- How does light allow us to see?
- Why do we see colors?
- How are waves used to transfer energy and information?
- How do modern ways of communication utilize patterns to transfer information without wires or fibers?

### Enduring Understandings & Practices

**By the end of this unit, students will understand:**
- Some forms of energy travel in waves.
- Waves are regular patterns of motion caused by a disturbance and travel outward from their source.
- Light is a form of energy.
- Light in terms of wavelength and frequency:
  - In longitudinal waves, particles move in the same or opposite direction of the wave. In transverse waves, particles move up or down as the wave moves right or left.
- How light travels. In order for us to see, light must reflect off of objects.
- We see colors when they are reflected and other colors are absorbed. When we see white, we are seeing all the colors reflected. When we see black, all the colors were absorbed.
- Sound; how it is made; and how it travels through gases, liquids, and solids.
- Ways that people can communicate over long distances.
- The basic process for transmitting signals using sound, electromagnetic waves, and electricity.
- Analog and digital signals.
- Computers communicate using Binary, converting information into a list of 1s and 0s that relay information.

**By the end of this unit, students will be able to:**
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
- Develop a model to describe phenomena. (4-PS4-2)
- 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)
<table>
<thead>
<tr>
<th>Prior Learning</th>
<th>Effective Implementation Strategies</th>
</tr>
</thead>
<tbody>
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<td><strong>Grade 1:</strong></td>
<td>• Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community.</td>
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<td>• People use a variety of devices to communicate (send and receive information) over long distances.</td>
<td>• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).</td>
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<td>• Objects can be seen if light is available to illuminate them or if they give off their own light.</td>
<td>• Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).</td>
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<td>• Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam.</td>
<td>• Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).</td>
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<td>• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.</td>
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<td><strong>Future Learning</strong></td>
<td>• Use project-based science learning to connect science with observable phenomena.</td>
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<td><strong>Grade 7:</strong></td>
<td>• Structure the learning around explaining or solving a social or community-based issue.</td>
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<td>• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.</td>
<td>• Provide ELL students with multiple literacy strategies.</td>
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<td>• A sound wave needs a medium through which it is transmitted.</td>
<td>• Collaborate with after-school programs or clubs to extend learning opportunities.</td>
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<td>• Digitized signals (sent as wave impulses) are a more reliable way to encode and transmit information.</td>
<td>• Restructure lesson using UDL principals (<a href="http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA">http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA</a>).</td>
</tr>
<tr>
<td>• In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.</td>
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### Assessment

**End-of-Unit Performance Assessment** Carnival Funhouse - Students will use their knowledge of waves, light, mirrors and reflections, and patterns of communication to construct a plausible explanation for the distorted reality and a method for communication with their friends while inside a funhouse.

Please click [HERE](#) to access our 2018-2019 K-5 Design Rubric.

**Suggested Hands-On Activities / Classroom Inquiries:**
Paper Waves, Making Water Waves, iPhone Hologram Projector, Light Reflection, Do You Hear What I Hear?, Can You Hear Me Now?, Binary Code Lab

The following is a recommended progression to support the development of understandings necessary for the performance expectation(s). Teachers should consider multiple data points when making instructional decisions.

*(Please note: Though listed individually, some experiences may last longer than one class period. Time has been built into the pacing calendar to allot for this.)*

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-[Science Questioning Graphic Organizer](#)  
-QFT: [Formulating effective questions](#)  
-Ideas For Phenomena To Question:  
-NGSS Phenomena  
-#ProjectPhenomena  
-Additional Resources:  
-Phenomenon Sample: [Rubber duck in a glass bowl](#) (light), [Helium voice changing](#) (sound)  
-Google Slides Unit Presentation  
-[DE Engage: Waves](#) |
| 1 | Waves are regular patterns of motion. | -Google Slides Unit Presentation  
-[DE Engage: Waves](#) |
| 2  | Investigate the properties of waves: What are waves? What are some examples of waves? How do waves travel? | -DE Explore: Waves  
-DE Waves Exploration |
| 3  | Describing Waves: Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). | -DE Elaborate: Waves (Video)  
-Google Slides Unit Presentation |
| 4  | Develop a model to describe a scientific principle. | -Paper Wave Lab (Teacher’s Notes) |
| 5  | Examine how waves are formed, how they move, and how they affect objects in the water. | -DE Hands-On Activity: Making Water Waves |
| 6  | Introduction to Light | -Google Slides Unit Presentation |
| 7  | Define light as a form of energy. | -DE Engage: Light Energy |
| 8  | Introduction to Color | -Teacher Demonstration: How To Turn Your iPhone Into A Hologram Projector  
-Google Slides Unit Presentation |
| 9  | Experience how white light passing through a prism separates into different colors of light.  
-Discover that a colored object reflects light of that color while absorbing all others.  
-Understand that a white object reflects light of all colors while a black object absorbs them. | -DE Exploration: Color |
| 10 | Recognize that visible light is made up of waves of different wavelengths.  
-Explain that as wavelength increases, frequency decreases.  
-Understand similarities and differences in patterns can be used to sort and classify natural phenomena. | -DE Exploration: On Your Wavelength |
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| 11 | **-**Describe what happens when light hits both a smooth and rough surface.  
-**Explain that a plane mirror reflects light at the same angle it hits it and reflects an object the same distance away as it is from the mirror.  
-Understand light bends as it passes from one material to another. | **-DE Engage: Reflection  
-Light Reflection Lab Presentation  
-Light Reflection Lab (Teacher’s Notes)** |
| 12 | **Define sound as a form of energy.** | **-Google Slides Unit Presentation  
-Mystery Science: What Would Happen if you Screamed in Outer Space?  
-Defined STEM: Audiologist** |
| 13 | **-Describe sound, how it is made, and establish the relationship between pitch and wavelength.  
-Explore how sound travels through gases, liquids, and solids.** | **-DE Engage: Sound Waves  
-Mystery Science: Why are some sounds high and some sounds low?** |
| 14 | **Compare the way sound moves through different objects.** | **-DE Hands-On Activity: Do you Hear What I Hear?** |
| 15 | **-Uncover ways that people can communicate over long distances.  
-The basic process for transmitting signals using sound, electromagnetic waves, and electricity.** | **-Google Slides Unit Presentation  
-Mystery Science: How far can a whisper travel?** |
| 16 | **Identify the receipt and processing of information.** | **-DE Hands-On Lab: Can You Hear Me Now?** |
| 17 | **Decode a set of digitized information.** | **-Binary Code Lab  
(Teacher’s Notes)** |
| 18 | **Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.** | **-Wave, Light, and Information Performance Based Assessment  
-Carnival Funhouse** |
| Improve | **Students are given time to revise their projects/solutions and finalize their plans based on the feedback of their peers and teacher(s).** | **-Individuals or groups modify their designs to incorporate feedback.** |
### Additional Classroom 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.

The [Utah Education Network](https://www.uen.org) has created several resources for fourth grade science teachers.

**Study Jams: Sound**

**Making a Periscope:** Students create a periscope.

### Teacher Professional Learning Resources

**NSTA Web Seminar: NGSS Core Ideas: Waves and Their Applications in Technologies for Information Transfer:** 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?”

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

**Bozeman Science:** A collection of videos covering all NGSS Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas.
## Unit 5: TransDisciplinary Unit - Energy & Natural Resources

<table>
<thead>
<tr>
<th>Grade:</th>
<th>4th</th>
<th>Suggested Pacing:</th>
<th>45 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain:</td>
<td>Physical Science</td>
<td>Discovery TechBook Unit:</td>
<td>Various</td>
</tr>
</tbody>
</table>

### NJSLS - Science Performance Expectations:

- **4-PS3: Energy**
  - Use evidence to construct an explanation relating the speed of an object to the energy of that object. (4-PS3-1).
  - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. (4-PS3-2)
  - Ask questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3)
  - Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (4-PS3-4)

- **4-ESS3: Earth and Human Activity**
  - Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (4-ESS3-1)

- **3-5-ETS1: Engineering Design**
  - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)
  - 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)

### NJSLS - Science Disciplinary Core Ideas:

- **PS3.A: Definitions of Energy**
  - The faster a given object is moving, the more energy it possesses. (4-PS3-1)
  - Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2) (4-PS3-3)

- **PS3.B: Conservation of Energy and Energy Transfer**
  - Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) (4-PS3-3)
  - Light also transfers energy from place to place. (4-PS3-2)
  - Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2) (4-PS3-4)
### NJSLS - Science Disciplinary Core Ideas (continued):

- **PS3.C: Relationship Between Energy and Forces**
  - When objects collide, the contact forces transfer energy so as to change the objects’ motions. (4-PS3-3)

- **PS3.D: Energy in Chemical Processes and Everyday**
  - The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

- **ESS3.A: Natural Resources**
  - Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

- **ESS1.A: Defining Engineering Problems**
  - Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

### NJSLS - Science CrossCutting Concepts:

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

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

- **Interdependence of Science, Engineering, and Technology:**
  - Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

- **Influence of Engineering, Technology, and Science on Society and the Natural World:**
  - Over time, people’s needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
  - Engineers improve existing technologies or develop new ones. (4-PS3-4)

- **Science is a Human Endeavor:**
  - Most scientists and engineers work in teams. (4-PS3-4)
  - Science affects everyday life. (4-PS3-4)

### NJSLS - Technology:

- **8.1 Educational Technology**
  - Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems. (8.1.5.A.1)
  - Use digital tools to research and evaluate the accuracy of, relevance to, and appropriateness of using print and non-print electronic information sources to complete a variety of tasks. (8.1.5.E.1)
  - Apply digital tools to collect, organize, and analyze data that support a scientific finding. (8.1.5.F.1)
<table>
<thead>
<tr>
<th><strong>NJ Social and Emotional Learning Competencies:</strong></th>
<th><a href="https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf">https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf</a></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overarching Local/Global Problem:</strong></td>
<td>Edison Township keeps losing power. The electrical grid, the system for delivering electricity from suppliers to consumers, is essential to the citizens’ lives. The mayor has asked that improvements be made to the city’s electrical system. What energy sources and converters would help bring energy to the people who live in the community?</td>
</tr>
<tr>
<td><strong>Essential Questions</strong></td>
<td><strong>The questions below are suggested EQs to guide the unit. NGSS was composed for students to drive learning. Afford children the opportunity to ask the question and define potential problems as the unit progresses.</strong></td>
</tr>
<tr>
<td></td>
<td>● How does human energy use impact the environment?</td>
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<td></td>
<td>● How can various forms of energy be used to solve a problem?</td>
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<tr>
<td><strong>Enduring Understandings &amp; Practices</strong></td>
<td>By the end of this unit, students will understand:</td>
</tr>
<tr>
<td></td>
<td>● Energy is an objects’ ability to do work.</td>
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<td></td>
<td>● Energy can be kinetic or potential, and has many different forms.</td>
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<td></td>
<td>● Energy shifts between kinetic and potential.</td>
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<td></td>
<td>● Energy is not created or destroyed.</td>
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<td></td>
<td>● Energy is transferred among its various forms.</td>
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<td>● Force is a way that energy can be transferred.</td>
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<td></td>
<td>● Producing energy refers to converting energy from one form to another so that it can be used for practical purposes.</td>
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<td></td>
<td>● Devices must be designed, tested, and refined in order to convert energy.</td>
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<td></td>
<td>● Renewable energy is energy that comes from a source that replenishes quickly and will not be used up before more is created.</td>
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<tr>
<td></td>
<td>● Non-renewable energy is energy that comes from a source that is very slow to replenish and can be used up.</td>
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<td></td>
<td>● Humans use energy and fuels derived from natural sources.</td>
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<td></td>
<td>● Human energy use has many impacts on the environment.</td>
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<tr>
<td>By the end of this unit, students will be able to:</td>
<td>● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)</td>
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<td></td>
<td>● 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)</td>
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<tr>
<td></td>
<td>● Use evidence to construct an explanation. (4-PS3-1)</td>
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<td></td>
<td>● Apply scientific ideas to solve design problems. (4-PS3-4)</td>
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<tr>
<td></td>
<td>● Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)</td>
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<tr>
<td><strong>Prior Learning</strong></td>
<td><strong>Kindergarten:</strong></td>
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<tr>
<td></td>
<td>● When objects touch or collide, they push on one another and can change motion.</td>
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<tr>
<td></td>
<td>● Pushes and pulls can have different strengths and directions.</td>
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<tr>
<td></td>
<td>● Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.</td>
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</tbody>
</table>
Grade 3:
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Future Learning

Grade 5:
- The energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).
- Plants acquire their material for growth chiefly from air and water.

Grade 6:
- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law)
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

Grade 8:
- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
Effective Implementation Strategies

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

Assessment

End-of-Unit Performance Assessment: Culminating Task: Groups of students will design a “machine” that the township can use to help generate power. Each machine must transfer energy in two different ways. Machines will be graded using the District Rubric.

Please click HERE to access our 2018 - 2019 K-5 Design Rubric.

Labs/Classroom Experiments: Build a marble roller coaster, Build a solar oven, build a wind turbine, Create a working circuit, Marble collisions experiment, Falling Water activity, Light Energy Investigation with flashlights, Sound Energy Investigation with tuning forks

The following progression supports the development of understandings necessary for the performance expectations. Teachers should consider multiple data points when making instructional decisions.

(Please note: Though listed individually, some experiences may last longer than one class period. Time has been built into the pacing calendar to allot for this.)

<table>
<thead>
<tr>
<th>Experiences</th>
<th>Daily Objective</th>
<th>Classwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Questioning Opportunity</td>
<td>To spark curiosity and amplify engagement, students should formulate their own questions regarding the phenomena/topic of the unit. They should then be afforded an opportunity to investigate them (and others that emerge) throughout the unit in order to heighten authenticity and</td>
<td>-KWHLAQ: Organizer</td>
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<tr>
<td></td>
<td></td>
<td>-KWHLAQ: Google Slides</td>
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<tr>
<td></td>
<td></td>
<td>-Science Questioning Graphic Organizer</td>
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<td></td>
<td></td>
<td>-QFT: Formulating effective questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Ideas For Phenomena To Question:</td>
</tr>
</tbody>
</table>
| 1 | Students will define a simple engineering problem related to constraints due to materials, cost, or time. | **Present Design Challenge:**
After the last power failure, “The Township” is looking for new and innovative “machines” to help keep the town up and running, as well as conserving energy. You work for a company that wants to present their new invention to the township. |
| 2 | Students will make observations that energy can be kinetic or potential, and has many different forms. | What is Energy?
What is Energy Video
Potential and Kinetic Energy Video
Teacher’s Guide
Student Investigation Sheet
Hands-On Activity - Energy in the Classroom |
| 3 | Students will use evidence to construct an explanation relating the speed of an object to the energy of that object. (Students Build Marble Roller Coasters) | **Mystery Science:** What makes roller coasters go so fast?
**Mystery Science:** Why is the first hill of a roller coaster always the highest?
- Review definition of energy and its 2 main forms: potential and kinetic
- Explain that students will be creating roller coasters with simple items to demonstrate energy and motion
- Show Marble Roller Coaster video
- Discuss students’ prior knowledge about roller coasters and how they work.
- Watch Roller Coaster Physics
- Create groups of students, Give them hard paper plates and a marble. (Tell them they’ll create a roller coaster their marble can ride. Students will cut the outside rims off the plates to create the track.) Example (to use if stuck)
- Monitor students as they create, discuss the potential energy of the groups marbles, and how the speed of the marble impacts its energy
- Groups will present roller coasters to the class. Point out that a marble will never climb a hill higher than the first. Give groups an opportunity to refine their roller coasters. From: Better Lesson |
<p>| | | |</p>
<table>
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</table>
| 4 | Students will make observations that can be kinetic or potential, and has many different forms. | Forms of Energy - students will gather relevant information from additional print and digital sources and take notes on graphic organizer.  
**Mystery Science:** [How can a Car Run Without Gas?](#)  
**Sound Energy**  
  - **Video**  
  - **Sound Energy Text**  
  - **Forms of Energy - Sound Energy (8:38 - 9:54)**  
  - **Mechanical Energy**  
  - **Mechanical Energy Text**  
  - **Video - Mechanical Energy (1:28-2:02)**  
  - **Electrical Energy**  
  - **Electrical Energy Text**  
  - **Forms of Energy - Electrical Energy (7:24 - 8:38)**  
  - **Light Energy**  
  - **Youtube**  
  - **Light Energy Text**  
  - **Forms of Energy - Light Energy (5:17 - 7:17)**  
  - **Thermal Energy**  
  - **Youtube**  
  - **DE Techbook Exploration: Thermal Energy**  
  - **Thermal Energy Text**  
  - **Forms of Energy - Thermal Energy (3:39 - 5:17)** |
| 5 | Students will make observations that can be kinetic or potential, and has many different forms. | **DE Techbook Fun-damental:** [Sound, Light, and Heat](#)  
[Student Guide](#)  
[Teacher Guide](#) |
| 6 | Students will make observations that can be kinetic or potential, and has many different forms. | Students watch Electricity video on Study Jams and take on line quiz.  
**Study Jams on Scholastic:** [Electricity](#)  
**Mystery Science:** [What if There were no Electricity?](#) |
<table>
<thead>
<tr>
<th>Page</th>
<th>Activity Description</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Students will ask questions and predict outcomes about the changes in energy that occur when objects collide.</td>
<td>In this lesson, students use marbles of various sizes to see how collisions can transfer energy from one object to another. [Colliding Marbles: PDF]</td>
</tr>
<tr>
<td>8</td>
<td>Students will make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</td>
<td>Thermal Energy: Students use the table &quot;How Heat Moves&quot; and write three observations they can make about the table and compare and contrast the three ways heat moves on the graphic organizer. <a href="#">How Heat Moves Table</a> <a href="#">How Heat Moves Document</a> <a href="#">Sample Responses - How Heat Moves Document</a> <a href="#">Defined STEM: Planning Commission: Urban Heat Islands</a></td>
</tr>
<tr>
<td>9</td>
<td>Students will make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</td>
<td>Light Energy Investigation: <a href="#">Light Energy Investigation Document</a></td>
</tr>
<tr>
<td>10</td>
<td>Students will make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</td>
<td>Sound Energy Investigation: <a href="#">Sound Energy Investigation Document</a></td>
</tr>
<tr>
<td>11</td>
<td>Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.</td>
<td>Energy Changes Activity: Students match each “Energy Changes” card with its corresponding photo card. They will use the graphic organizer and complete chart with how energy is transferred for each photo. In complete sentences, they will explain how energy is converted for one of the photo cards. <a href="#">Energy Changes Photo Cards</a> <a href="#">Energy Changes Cards</a> <a href="#">Energy Changes Graphic Organizer</a></td>
</tr>
</tbody>
</table>
| 12 | Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. | Light It Up!  
*Before activity: Use wire cutters to clip off a section of holiday lights that includes one or more bulbs and the cord on each side of it. Use wire strippers or a small sharp knife to peel back the plastic coating on each end of the section.*  
-Students will need about 2.5 cm (1 in.) of exposed wire on each end.  
-Test the bulb by using electrical tape to attach one exposed wire to one end of a D cell battery and the other exposed wire to the other end of the battery. The bulb should light.  
**Never allow both ends of the wire to touch the ends of the battery for longer than 8–10 seconds because the wire can become very hot.**  
[Light It Up! Investigation Document](http://example.com) |
| 13 | Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. | [Creative Circuits](http://example.com)  
[Creative Circuits Document](http://example.com) |
| 14 | Obtain and combine information from books and other reliable media to explain phenomena. | Students will research energy discoveries and scientists - [Energy Timelines and Famous People in the History of Science](http://example.com)  
Present using visual medium (Google Slides, Powtoon, etc…) or written report |
| 15 | Students will obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. | Introductory Question: What are the different Energy sources used in the US?  
-Give students the names of the energy sources: Coal, Petroleum, Hydroelectric, Nuclear, Natural Gas, Other Renewable(solar, wind, biomass)  
-SW rank them in the order from least to greatest usage in the US based on their knowledge  
-[Power Up -Discovery Techbook Exploration](http://example.com)  
-Discuss their ranking with the actual percentages in the US  
-SW fill in advantages/disadvantages chart from Discovery TechBook  
-SW Discuss preliminary answers to the overarching question |
| 16 | Students will obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. | -Review previous day  
-View video  
-Students or teachers form groups to research 1 type of energy  
Possible Sources: Energy Kids Articles Research Project outline from NJCTL  
-Students will find the information on their organizers, then create a presentation  
-Choice Menu  
-Rubric (attached to research project plan) |
| 17 | Students will obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. | -Brainpop-Solar Energy-True and false statements  
-SW read about different uses for solar power in a jigsaw activity  
-Solar Power Jigsaw and Articles  
-SW answer open ended question |
| 18 | Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. | Students will create a solar oven:  
Students will need to bring in cardboard boxes prior to this experience (Pizza and large shoe boxes would be best)  
Teacher info and video  
-Give students solar oven challenge  
-Groups will collect their necessary items to build oven  
The document says to use plexiglass-Substitute plastic wrap instead.  
-Throughout the day SW create a line graph of the temp in their oven |
| 19 | Students will obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.  
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. | -Brain Pop- Wind energy  
-Review history of wind power with class.  
-Wind Farms- Explore pictures  
-Working With Wind Activity  
You will need a hairdryer and many other supplies for this activity.  
-Defined STEM: Wind Energy Systems Installer: Energy Transformations  
-Wind Energy (extra resources) |
| 20 | Students will obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. | -Compose a written composition about whether a wind farm -- even if it would provide energy to the local area -- would be a good idea to put in the center of your hometown. What about on the Thames River in London or just off of a resort beach area?  
-Defined STEM: Earth Scientist: Alternative Energy |
| 21 | Students will obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. | **Falling Water Activity**  
-Defined STEM: **Green Housing** |
| 22 | Design Challenge | **Design Challenge**  
-Present machines to “the township”. Explain why/how your machine will help the town conserve energy. |
| Improve | Students are given time to revise their projects/solutions and finalize their plans based on the feedback of their peers and teacher(s). | -Individuals or groups modify their designs to incorporate feedback. |

### Additional Classroom Resources

- **Can you Build a Chain Reaction Machine?:** Mystery Science exploration and activity
- **Could you Knock Down a Building using only Dominoes?:** Mystery Science exploration and activity
- **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.
- **Switch Energy Project:** The Educator Portal provides free access to a documentary, energy labs, videos, and study guides.
- **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.
- **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.
- **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.
**Teacher Professional Learning Resources**

**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.

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

**Bozeman Science:** A collection of videos covering all NGSS Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas.
## Unit 6 - Molecules to Organisms: Plant & Animal Structures and Processes

<table>
<thead>
<tr>
<th>Grade:</th>
<th>4th</th>
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<tbody>
<tr>
<td>Suggested Pacing:</td>
<td>45 days</td>
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</table>

### Domain:
- **Life Science**

### Discovery TechBook Unit:
- **Systems for Survival**

### NJ SLS - Science Performance Expectations:

<table>
<thead>
<tr>
<th>4-LS1: From Molecules to Organisms: Structures and Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. (4-LS1-1)</td>
</tr>
<tr>
<td>○ Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)</td>
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<table>
<thead>
<tr>
<th>4-PS4 Waves and Their Applications in Technologies for Information Transfer</th>
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<tr>
<td>○ Develop a model to describe that light reflecting from objects and entering the eyes allows objects to be seen. (4-PS4-2)</td>
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<table>
<thead>
<tr>
<th>3-5-ETS1: Engineering Design</th>
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<tbody>
<tr>
<td>○ 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)</td>
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### NJ SLS - Science Disciplinary Core Ideas:

<table>
<thead>
<tr>
<th>PS4.B: Electromagnetic Radiation</th>
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<tbody>
<tr>
<td>○ An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)</td>
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<table>
<thead>
<tr>
<th>LS1.A: Structure and Function</th>
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<tbody>
<tr>
<td>○ Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)</td>
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</table>

<table>
<thead>
<tr>
<th>LS1.D: Information Processing</th>
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<tbody>
<tr>
<td>○ 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)</td>
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<table>
<thead>
<tr>
<th>ETS-1 Asking Questions and Defining Problems</th>
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<tbody>
<tr>
<td>○ Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</td>
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</table>

### NJ SLS - Science CrossCutting Concepts:

<table>
<thead>
<tr>
<th>Cause and Effect:</th>
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<tbody>
<tr>
<td>○ Cause and effect relationships are routinely identified, tested, and used to explain change (4-ESS2-1), (4-ESS3-2)</td>
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<tr>
<th>System and System Models:</th>
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<tbody>
<tr>
<td>○ A system can be described in terms of its components and their interactions. (4-LS1-1), (LS1-2)</td>
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### NJ Social and Emotional Learning Competencies:

- [https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf](https://www.state.nj.us/education/students/safety/sandp/sel/SELCompetencies.pdf)
## Essential Questions**

*The questions below are suggested EQs to springboard the unit. NGSS was composed for students to drive learning. Afford children the opportunity to ask the questions and define potential problems.*

- How do organisms live, grow, respond to their environment, and reproduce?
- How do organisms detect, process, and use information about the environment?
- How and why do organisms interact with their environment and what are the effects of these interactions?
- How do the structures of organisms enable life’s functions?

## Enduring Understandings & Practices

**By the end of this unit, students will understand:**

- How plant and animal structures, both internally and externally, function to fulfill life processes.
- The core four functions of organisms: growth, survival, behavior and reproduction.
- Identify that sensory information is processed in the brain.
- How senses benefit animals in respect to how they respond to their environment.

**By the end of this unit, students will be able to:**

- Develop a model to describe phenomena. (4-PS4-2)
- Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)
- Construct an argument with evidence, data, and/or a model (4-LS1-1)

## Prior Learning

**Grade 1:**

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

**Grade 3:**

- Different organisms vary in how they look and function because they have different inherited information.
- The environment also affects the traits that an organism develops.
### Future Learning

**Grade 7:**
- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.
- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.
- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary)
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary)

### Effective Implementation Strategies

- Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles ([http://www.cast.org/our-work/about-udl.html#VXmoXcfD-UA](http://www.cast.org/our-work/about-udl.html#VXmoXcfD-UA)).

### Assessment

**End-of-Unit Performance Assessment:** *Amazing Animal Senses:* Students will investigate an animal with a sense organ that humans do NOT have. They will research information about the animal and use a model to demonstrate how that animal uses that sense organ to interact with its environment. Please click [HERE](http://www.cast.org/our-work/about-udl.html#VXmoXcfD-UA) to access our 2018 - 2019 K-5 Design Rubric.

**Suggested Hands-On Activities / Classroom Inquiries:**
- How do Plants Breathe, Internal Organ System Activity, Optical Illusion, Reaction Time, Habitat Hide and Seek, Kaleidoscope Construction
The following is a recommended progression to support the development of understandings necessary for the performance expectation(s). Teachers should consider multiple data points when making instructional decisions.

(Please note: Though listed individually, some experiences may last longer than one class period. Time has been built into the pacing calendar to allot for this.)

<table>
<thead>
<tr>
<th>Experience</th>
<th>Objective/Desired Outcome</th>
<th>Classwork Resources</th>
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</table>
| Student Questioning Opportunity | To spark curiosity and amplify engagement, students should formulate their own questions regarding the phenomena/topic of the unit. They should then be afforded an opportunity to investigate them (and others that emerge) throughout the unit in order to heighten authenticity and deepen their knowledge and understanding. Teachers may use these questions as a pre-assessment and as a means to guide future learning experiences. | -KWHLAQ: Organizer  
-KWHLAQ: Google Slides  
-Science Questioning Graphic Organizer  
-QFT: Formulating effective questions  
-Ideas For Phenomena To Question:  
-NGSS Phenomena  
-#ProjectPhenomena  
-Additional Resources: Phenomenon samples: Treehopper Ant, Smart Moth, Penguin Water Exit |
| 1 | Explore how plant and animal structures function to fulfill life processes. | -Google Slides Unit Presentation  
-DE: Explore Session 4 |
| 2 | Further investigate how plant and animal structures function to fulfill life processes. | -Google Slides Unit Presentation  
-How Do Plants Breathe?  
-Defined STEM: Botanical Design |
| 3 | Compare the stages of growth and development of different animals. | -Google Slides Unit Presentation  
-DE: Engage - Growth and Development  
-DE: Exploration - Growth and Development |
| 4 | Explain how plant and animal structures function to fulfill life processes | -Google Slides Unit Presentation  
-DE: Physical Features-Assignment 1  
-Defined STEM: Dietitian |
| 5 | Describe how animals grow and change over time. | -DE: Explore - Growth and Development  
-Defined STEM: Efficiency Expert: Zoos |
| 6 | Analyze how plant and animal structures function to fulfill life processes. | -Google Slides Unit Presentation  
/Internal Organ System Activity |
<p>| 7 | Explore how the structure of animals’ teeth support their function | -Bite Into Structure and Function (Teacher's Notes) (Presentation) |</p>
<table>
<thead>
<tr>
<th>8</th>
<th>Explore why animals need shelter.</th>
<th>-<strong>DE:</strong> Explore Shelter and Defense</th>
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</table>
| 9 | Determine the habitat needs of an animal. | -**DE:** Virtual Lab: Save the Black-Footed Ferret  
-**Defined STEM:** Ecologist: Invasive Species |
| 10 | Compare and contrast the features of different animals relative to their survival. | -**DE:** Hands on Activity Comparing Physical Features of Animals (TE)  
-**Student Sheet** |
| 11 | Design animals that can camouflage in a chosen habitat. | -**DE:** Hands on Activity: Habitat Hide and Seek  
**Student Guide** |
| 12 | Understand different sense receptors are specialized for particular kinds of information. | -Google Slides Unit Presentation  
-**Mystery Science:** How can some animals see in the dark? |
| 13 | Uncover that sensory information is processed in the brain. | -Google Slides Unit Presentation  
-**DE:** Hands-On Activity: Optical Illusion  
-**Mystery Science:** How does your brain control your body?  
-**Mystery Science:** What do blind people see? |
| 14 | Further explore that sensory information is processed in the brain. | -Google Slides Unit Presentation  
-**DE:** Hands-On Lab: Reaction Time |
| 15 | End- of- Unit Performance Assessment | **Amazing Animal Senses:** Students will investigate an animal with a sense organ that humans do NOT have. They will research information about the animal and use a model to demonstrate how that animal uses that sense organ to interact with its environment.  
-Individuals or groups modify their designs to incorporate feedback. |

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**Additional Classroom 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.

**Planting Thoughts:** Students gain an understanding of the parts of a plant, plant types and how they produce their own food from sunlight through photosynthesis. They also learn about transpiration, the process by which plants release moisture to the atmosphere. With this understanding, students test the effects of photosynthesis and transpiration by growing a plant from seed. They learn how plants play an important part in maintaining a balanced environment in which the living organisms of the Earth survive.
Using Sound Waves to See: Students learn about echolocation: what it is and how engineers use it to "see" things in the dark, or deep underwater. They also learn how animals use echolocation to catch their meals and travel the ocean waters and skies without running into things.

Teacher Professional Learning Resources

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.

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