Science Grade 5

Length of Course: Term
Elective/Required: Required
Schools: Elementary
Eligibility: Grade 5
Credit Value: N/A
Date Approved: August 24, 2015
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STATEMENT OF PURPOSE

In July 2011, the National Research Council (NRC) of the National Academy of Sciences developed *A Framework for K-12 Science Education*. This guidance provides a sound, evidence-based foundation for standards by drawing on current scientific research - including research on the methods in which students learn science effectively - and identifies the science all students in grade K-12 should know.

This Framework was composed based on a set of core principles that:

- Reaffirm children are born investigators;
- Recognize understanding builds over time;
- Assert science & engineering require both knowledge and practice;
- Acknowledge a connection to students’ interests and experiences is essential;
- Focus on core ideas and practices; and
- Promote equity.

The NRC’s Framework describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises understanding. It presents three dimensions that will be combined to form each standard:

**Dimension 1: Practices**

Practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world. They also include the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term “practices” instead of a term like “skills” to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC’s intent is to better explain and extend what is meant by “inquiry” in science and the range of cognitive, social, and physical practices that it requires.

Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through an investigation, while engineering design involves the formulation of a problem that can be solved through design. Emphasizing the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering, and mathematics to everyday life.

**Dimension 2: CrossCutting Concepts**

The CrossCutting Concepts have application across all domains of science and, as such, are a way of linking different domains together. They include:

- Patterns, similarity, and diversity;
- Cause and effect;
- Scale, proportion, and quantity;
- Systems and system models;
- Energy and matter;
- Structure and function; and
- Stability and change.

The Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for inter-relating knowledge from various science fields into a coherent and scientifically-based view of the world.
Dimension 3: Disciplinary Core Ideas

Disciplinary Core Ideas have the power to focus K-12 science curriculum, instruction, and assessment on the most important aspects of science. To be considered core, the ideas meet at least two of the following criteria (and, ideally, all four):

- Have broad importance across multiple sciences or engineering disciplines, or be a key organizing concept of a single discipline;
- Provide a key tool for understanding or investigating more complex ideas and solving problems;
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge; and/or
- Be teachable and learnable over multiple grades at increasing levels of depth and sophistication.

Disciplinary Core Ideas are grouped in four domains: the physical sciences, the life sciences, the earth and space sciences; and engineering, technology, and applications of science.

The NRC’s Framework serves as the foundation of the Next Generation Science Standards (NGSS), a set of internationally-benchmarked science learning outcomes published in April 2013. NGSS proposes shifts in the teaching and learning of science to augment student engagement and strengthen connections between science, technology, engineering, and mathematics. Developed collaboratively with states and other stakeholders in science, science education, higher education, and industry, the NGSS present standards that are rich in content and practice and arranged in a coherent manner across disciplines and grades to prepare students for college and careers.

Our current K-5 Science instructional program reflects the learning and performance expectations found in the Next Generation Science Standards. The NGSS, adopted by the New Jersey State Board of Education in 2014, were officially renamed as the New Jersey Student Learning Standards for Science (NJSLS-S) in 2016.

The district’s curriculum is strategically designed to help students foster an understanding of the four domains of science from kindergarten through fifth grade.

In earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s).

The performance expectations in elementary school grade bands develop ideas and skills over time that will allow students to explain more complex phenomena in the four disciplines as they progress to middle and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific Disciplinary Core Ideas, informed instructional decisions based on formative and summative assessment should be made by the teacher to ensure understanding of the many science and engineering practices that lead to the performance expectations.

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Coordinated By: Steve Figurelli, District Supervisor of Elementary Education
5th Grade Science Curriculum Overview

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

- When matter changes, does its weight change? How much water can be found in different places on Earth?
- Can new substances be created by combining other substances?
- How does matter cycle through ecosystems?
- Where does the energy in food come from and what is it used for?
- How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?

Fifth grade performance expectations include PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3 Disciplinary Core Ideas from the National Research Council Framework.

**Physical Science:**

- Students are able to describe that matter is made of particles too small to be seen through the development of a model.
- Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved.
- Students determine whether the mixing of two or more substances results in new substances.

**Earth and Space Science:**

- Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- They describe and graph data to provide evidence about the distribution of water on Earth.
- Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
- Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. (Both ESS and LS)

**Life Science:**

- Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water.
- Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals’ food was once energy from the sun.

**Crosscutting Concepts:** The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these Disciplinary Core Ideas.

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

- Developing and using models;
- Planning and carrying out investigations;
- Analyzing and interpreting data;
- Using mathematics and computational thinking;
- 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 5th Grade.
# 5th Grade Science Scope & Sequence

## 1st Marking Period
### Physical Science - Forces & Interactions
#### Unit 1: Forces
(Suggested Pacing: 20 Days)

- **5-PS2: Motion and Stability: Forces and Interactions**
  - Support an argument that the gravitational force exerted by Earth on objects is directed down. (5-PS2-1)
- **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)

## Earth & Space Science - Stars & The Solar System
#### Unit 2: Earth And The Universe
(Suggested Pacing: 25 Days)

- **5-ESS1: Earth’s Place in the Universe**
  - Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. (5-ESS1-1)
  - Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. (5-ESS1-2)

## 2nd Marking Period
### Physical Science - Structure & Properties Of Matter
#### Unit 3: Matter & Its Interactions
(Suggested Pacing: 25 Days)

- **5-PS1: Matter and Its Interactions**
  - Develop a model to describe that matter is made of particles too small to be seen. (5-PS1-1)
  - Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (5-PS1-2)
  - Make observations and measurements to identify materials based on their properties. (5-PS1-3)
  - Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)

## Life/Physical Science - Matter & Energy In Organisms & Ecosystems
#### Unit 4: Energy In Organisms
(Suggested Pacing: 20 Days)

- **5-PS3: Energy**
  - Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. (5-PS3-1)
### Science Grade 5

<table>
<thead>
<tr>
<th>5-L51: From Molecules to Organisms: Structures and Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Support an argument that plants get the materials they need for growth chiefly from air and water. (5-L51-1)</td>
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#### 3rd Marking Period

<table>
<thead>
<tr>
<th>Life Science - Matter &amp; Energy In Organisms And Ecosystems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 5: Transdisciplinary Unit - Ecosystem Dynamics</td>
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<tr>
<td>(Suggested Pacing: 45 Days)</td>
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<th>5-PS3: Energy</th>
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<thead>
<tr>
<th>5-LS2: Ecosystems: Interactions, Energy, and Dynamics</th>
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<tbody>
<tr>
<td>○ Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. (5-LS2-1)</td>
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<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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<td>○ 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)</td>
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#### 4th Marking Period

<table>
<thead>
<tr>
<th>Earth &amp; Space Science - Earth’s Systems</th>
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<tbody>
<tr>
<td>Unit 6: Transdisciplinary Unit - Earth’s Systems &amp; Human Impacts On Earth</td>
</tr>
<tr>
<td>(Suggested Pacing: 45 Days)</td>
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</table>

<table>
<thead>
<tr>
<th>5-ESS2: Earth’s Systems</th>
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</thead>
<tbody>
<tr>
<td>○ Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (5-ESS2-1)</td>
</tr>
<tr>
<td>○ Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. (5-ESS2-2)</td>
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<th>5-ESS3: Earth and Human Activity</th>
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<tbody>
<tr>
<td>○ Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. (5-ESS3-1)</td>
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## UNIT 1

### Unit 1 - Forces

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<th>Grade:</th>
<th>5th</th>
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<tr>
<td><strong>Suggested Pacing:</strong></td>
<td>20 Days</td>
</tr>
<tr>
<td><strong>Domain:</strong></td>
<td>Earth &amp; Space Science</td>
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**Discovery TechBook Unit:** Earth’s Forces

### NJSLS- Science Performance Expectations:

- **5-PS2: Motion and Stability: Forces and Interactions**
  - Support an argument that the gravitational force exerted by Earth on objects is directed down. (5-PS2-1)

- **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 Idea:

- **PS2.B: Types of Interactions**
  - The gravitational force of Earth acting on an object near Earth’s surface pulls that object towards the planet’s center. (5-PS2-1)

### NJSLS- Science CrossCutting Concept:

- **Cause & Effect:**
  - Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)

### NJSLS - Technology:

- **8.2 Technology Education, Engineering, Design and Computational Thinking - Programming**
  - Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models. (8.2.5.C.4)
  - Explain the functions of a system and subsystems. (8.2.5.C.5)
  - Examine a malfunctioning tool and identify the process to troubleshoot and present options to repair the tool. (8.2.5.C.6)
  - Work with peers to redesign an existing product for a different purpose. (8.2.5.C.7)

### Essential Questions**

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

- How can one explain and predict interactions between objects and within systems of objects?
- How does gravity affect things on or near Earth?
- How do mass and distance affect the gravitational pull between objects.
- Why don’t the planets crash into each other or the Sun?
## Enduring Understandings & Practices

By the end of this unit, students will understand:
- Things on or near Earth are pulled toward Earth by gravity.
- How mass and distance relate to the force of gravity.
- Where the center of mass of a sphere is.
- How to use force and friction to slow down gravitational pull.

By the end of this unit, students will be able to:
- Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)
- Support an argument with evidence, data, or a model. (5-PS2-1), (5-ESS1-1)

## Prior Learning

**Grade 1**
- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

**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, but not quantitative addition of forces are 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.)
- Objects in contact exert forces on each other.
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

## Future Learning

**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.
- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).
- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.
### 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).

### Assessment

**End-of-Unit Performance Assessment:**
How Slow Can You Roll? - The objective of this design challenge will be to get a soda can to roll as slowly as possible to the bottom of a ramp. Students will apply what they have learned about gravity, force, and friction to accomplish this experience. Students will try out several different versions of designs, changing the design of the can and/or ramp. A final "contest" will be held where groups of students will compete and time each other’s designs to see whose can rolls the slowest down the ramp.

Please click [HERE](#) to access our 2017 - 2018 K-5 Design Rubric.

**Suggested Hands-On Activities / Classroom Inquiries:**
Race To The Bottom, Force Due To Gravity Simulation

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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</thead>
</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 |
|   | Understand concept of force | -Google Slides Unit Presentation  
|   |                        | -NJCTL hands on experiment: [Race to the Bottom](#)  
|   |                        | -DE Video: [Forces](#)  
| 2 | Gravity is a force | -Google Slides Unit Presentation  
|   |                        | -DE Articles: [What Goes Up Must Come Down](#), [Let's Get Away](#), [Getting to Know: Gravity](#)  
|   |                        | -DE Hands On Experience: [Universal Gravity](#)  
|   |                        | -DE Video: [Forces and Gravity](#)  
| 3 | Gravity is a force (continued) | -NJCTL Hands on Experiment: [Forces Due to Gravity Lab](#)  
|   |                        | -Google Slides Unit Presentation  
|   |                        | -DE Exploration: [Gravity](#)  
|   |                        | -DE Assignment: [Gravity Assignment 2](#)  
|   |                        | -Mystery Science (focus on friction): [How Can You Go Faster Down a Slide?](#)  
| 4 | Check for understanding | -DE Constructed Response: [Gravity](#)  
| 5 | Performance Assessment | -[How Slow Can You Roll?](#)  
|   |                        | Note: Students will be working in groups. Each group will need an empty soda can and a ramp. The ramps can be borrowed from 1st grade teachers from their previous balls and ramps unit OR you can create your own ramps using materials of your choice.  
| 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

- **Gravity and Falling Objects**: PBS Learning Media lesson where students investigate the force of gravity and how all objects, regardless of mass, fall to the ground at the same rate.
- **Gravity**: In this BrainPOP movie, Tim and Moby teach you all about the ins and outs of gravity. You’ll learn everything from Sir Isaac Newton’s famous apple to Albert Einstein’s theory that massive objects use gravity to “bend” space and time. You’ll also find out about gravity’s effect on tides, humans, and even the earth’s rotation.
- **Gravity**: Britannica School
- **What are Gravity and Drag?**: In this Design Squad video, see how gravity accelerates a bicyclist downhill while drag slows him down. A bike can speed up by either minimizing drag, which reduces resistance, or increasing the rider’s weight, which increases the force pulling the bike downhill.
- **Invisible Force**: In this Design Squad activity, design a setup so that when a steel ball rolls past a magnet, it changes direction and hits a target that’s sitting off to the side.
- **StudyJams: Gravity and Inertia**
- **DefinedSTEM: Aircraft Designer**
Science Grade 5

- **Gravity Activity Packet**: Discover Primary Science and Math Activity Packet includes 4 activities for students to investigate force of gravity.

- **Muscles, Muscles Everywhere**: Through the design of their own microgravity exercise machine, students learn about the exercise machines that engineers design specifically for astronaut use and discover how important it is for astronauts to get adequate exercise both on Earth and in outer space.

- **Teach Engineering**: Browse for Additional Lessons, Activities, and Units

- **Crash Course Science**: YouTube Video Channel for Kids

### Teacher Professional Learning Resources

**Framework for K-12 Science Education, Developing and Using Models**

This section of the Framework provides a deeper explanation of what it means for students to develop and use models. Modeling is especially important when concepts are too large or too small for students to have direct experience.

**APPENDIX F: Science and Engineering Practices in the NGSS**

The Framework uses the term “practices,” rather than “science processes” or “inquiry” skills for a specific reason: We use the term “practices” instead of a term such as “skills” to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. (NRC Framework, 2012, p. 30). Appendix F provides further clarification of each science and engineering practice as well as specific details about what each looks like in each grade band.

**NGSS Crosscutting Concepts: Stability and Change**

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

**NGSS Core Ideas: 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.

**Bozeman Science**

## UNIT 2

### Unit 2 - Earth & The Universe

<table>
<thead>
<tr>
<th>Grade:</th>
<th>5th</th>
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</thead>
<tbody>
<tr>
<td>Domain:</td>
<td>Earth &amp; Space Science</td>
</tr>
<tr>
<td>Suggested Pacing:</td>
<td>25 Days</td>
</tr>
<tr>
<td>Unit:</td>
<td>Patterns in the Sky</td>
</tr>
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</table>

### NJSLS- Science Performance Expectations:

- **5-ESS1: Earth’s Place in the Universe**
  - Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. (5-ESS1-1)
  - Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. (5-ESS1-2)

### NJSLS- Science Disciplinary Core Ideas:

- **ESS1.A: The Universe and its Stars**
  - The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)

- **ESS1.B: Earth and the Solar System**
  - The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)

### NJSLS- Science CrossCutting Concepts:

- **Patterns:**
  - Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2)

- **Scale, Proportion, and Quantity:**
  - Natural objects exist from the very small to the immensely large. (5-ESS1-1)

### 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 relative distance affect the brightness of a star?
- Why are some constellations only visible during certain times of the year?
- Why do shadows appear larger at certain times of the day and shorter at other times?
- What is the universe and what is Earth's place in it?
- What are the predictable patterns caused by Earth's movement in the solar system?
### 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>
</tr>
</thead>
<tbody>
<tr>
<td>● A star’s distance from Earth affects how bright it appears to be.</td>
<td>● Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)</td>
</tr>
<tr>
<td>● The length of shadows decrease during the day until they reach a certain point, then the shadows gradual start to get larger.</td>
<td>● Support an argument with evidence, data, or a model. (5-PS2-1), (5-ESS1-1)</td>
</tr>
<tr>
<td>● The rotation of Earth causes night and day.</td>
<td></td>
</tr>
<tr>
<td>● The path of the sun changes from month to month.</td>
<td></td>
</tr>
<tr>
<td>● The location of constellations change due to the rotation and revolution of Earth.</td>
<td></td>
</tr>
<tr>
<td>● Northern and Southern hemispheres have opposite seasons.</td>
<td></td>
</tr>
<tr>
<td>● Earth’s rotation on its axis creates the cycle of day and night.</td>
<td></td>
</tr>
<tr>
<td>● The sun is essential to life on Earth.</td>
<td></td>
</tr>
</tbody>
</table>

### Prior Learning

**Grade 1**
- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

### Future Learning

**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.
- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.
- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.
- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.
- This model of the solar system can explain eclipses of the sun and the moon. Earth’s spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.
### 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:**

Amateur Astronomer Design Challenge - The students will be completing a task in which they discover a new planet and are presented with the opportunity to defend why their planet should be considered a new planet in our solar system. Students will be completing a design challenge in which they will be tasked with the job of presenting an argument based on their learning and discovery from this unit.

Please click [HERE](http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) to access our 2017 - 2018 K-5 Design Rubric.

**Suggested Hands-On Activities / Classroom Inquiries** *(Please note: Many will take multiple class sessions):* Big Dipper Experiment, Viewing Stars, Hide & Seek Stars, Luminosity Lab, Investigating Shadows, Observing Shadows, When’s The Shadow There?, Seasons 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.)*
<table>
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<th>Objective/Desired Outcome</th>
<th>Classwork Resources</th>
</tr>
</thead>
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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  
HYPERLINK "https://sites.google.com/site/sciencephenomena/" #ProjectPhenomena |
| 1 | The Universe/Constellations - Understand what the universe is and its place in our solar system | -Google Slides Unit Presentation  
-DE video: A Spin Around The Solar System  
-DE exploration: Your Place in Space |
| 2 | Constellations - Explore and understand what constellations are | -DE exploration: Constellations  
-Google Slides Unit Presentation  
-DE student sheet: Constellations |
| 3 | Constellations - Explore constellations | -NJCT: Big Dipper Experiment  
-Constructed response: Constellations |
| 4 | Stars - Understand what stars are and role in solar system | -DE hands on: Viewing Stars  
-DE video: Stars  
-NJCTL hands on: Hide & Seek Stars  
-Mystery Science: What Are The Wandering Stars? |
| 5 | Stars - Understand the relationship between light sources and distance | -DE experiment: Brightness and Distance of Stars  
-Mystery Science: Why Do The Stars Change With The Seasons? |
| 6 | The Sun - Understanding the sun and it’s impact on our solar system | -Google Slides Unit Presentation  
-DE reading: Our Star The Sun |
| 7 | The Sun - Understanding why stars don’t appear as bright as our sun | -NJCTL hands on: Luminosity lab  
-Google Slides Unit Presentation  
-Defined STEM: Astronomer (Locating a Telescope) |
| 8 | Observable Patterns - Cycles of Day and Night | -DE video: Earth’s movement  
-DE article: The Cycles of Day and Night  
-DE assignment: Cycles of Day and Night  
-Mystery Science: Why Does The Sun Rise and Set? |
| 9 | Observable Patterns - Cycles of Day and Night (optional assessment piece) | -DE assignment/Essential Questions (can be used as an assessment piece): Essential Questions  
-Mystery Science: Why Does The Moon Change Shape? |
| 10 | Observable Patterns - Understand how shadows angles and lengths play out in the course of a day | -DE hands on lab: Investigating Shadows  
-NJCTL: Observing Shadows  
-DE virtual lab on shadows: When’s The Shadow There? |
|   | Observable Patterns - Seasons | -DE article: [Getting to Know the Seasons](#)  
|   |                              | -DE video: [The Reason For The Seasons](#)  
|   |                              | -DE virtual lab: [Seasons](#)  
|   |                              | -Mystery Science: [How Can The Sun Tell You The Season?](#)  
|   | Observable Patterns - Northern and Southern hemispheres | -DE video: [Seasons in the Northern and Southern Hemispheres](#)  
|   |                              | -DE activity: [Graphing activity on North/South](#)  
|   | Unit Review                  | -Review questions from NJCTL  
|   | Performance Assessment       | -Amateur Astronomer Design Challenge  
|   |                              | -Amateur Astronomer Graphic Organizer  
|   | Improve                      | -Individuals or groups modify their designs to incorporate feedback.  

**Additional Classroom Resources**

- NASA’s [Solar System Exploration](#) website contains several resources that educators and students can use to make sense of the night sky.  
- [Seasons](#): Britannica School  
- [Our Super Star](#): PBS Learning Media lesson that guides students to understand the basic facts about the Sun, model the mechanics of day and night, and use solar energy to make a tasty treat.  
- [A Year on Earth](#):  
- [Solar System](#): In this BrainPOP movie, Tim and Moby take you back to the birth of our home in space and give you a virtual tour of our galactic neighborhood!  
- [Seasons](#): In this BrainPOP movie, Tim and Moby will show you how the tilt of the earth and its orbit around the sun affect the changing weather.  
- [Constellations](#): In this BrainPOP movie, learn how constellations move across the sky every night, and why some of them are only visible during certain months.  
- [Solstice & Equinox](#): In this BrainPOP movie, Tim and Moby identify the first days of spring, summer, fall, and winter. From the vernal equinox to the summer solstice to the autumnal equinox to the winter solstice, you’ll follow the sun’s changing paths across the sky from one season to the next.  
- [StudyJams: Seasons](#)  
- [StudyJams: A Day on Earth](#)  
- [Teach Engineering](#): Browse for Additional Lessons, Activities, and Units  
- [Crash Course Science](#): YouTube Video Channel for Kids

**Teacher Professional Learning Resources**

*Framework for K-12 Science Education, Developing and Using Models*

This section of the Framework provides a deeper explanation of what it means for students to develop and use models. Modeling is especially important when concepts are too large or too small for students to have direct experience.  

**APPENDIX F: Science and Engineering Practices in the NGSS**

The Framework uses the term “practices,” rather than “science processes” or “inquiry” skills for a specific reason: We use the term “practices” instead of a term such as “skills” to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. (NRC...*
Framework, 2012, p. 30). Appendix F provides further clarification of each science and engineering practice as well as specific details about what each looks like in each grade band.

**NGSS Crosscutting Concepts: Stability and Change**

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

**NGSS Core Ideas: 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.

**Bozeman Science**

## UNIT 3

### Unit 3 - Matter & Its Interactions

<table>
<thead>
<tr>
<th>Grade:</th>
<th>5th</th>
<th>Suggested Pacing:</th>
<th>25 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain:</td>
<td>Physical Science</td>
<td>Discovery TechBook Unit:</td>
<td>Various</td>
</tr>
</tbody>
</table>

### NJSSLS- Science Performance Expectations:

- **5-PS1: Matter and Its Interactions**
  - Develop a model to describe that matter is made of particles too small to be seen. (5-PS1-1)
  - Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (5-PS1-2)
  - Make observations and measurements to identify materials based on their properties. (5-PS1-3)
  - Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)

### NJSSLS- Science Disciplinary Core Ideas:

- **PS1.A: Structure and Properties of Matter**
  - Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)
  - The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
  - Measurements of a variety of properties can be used to identify materials. *(Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)* (5-PS1-3)

- **PS1.B: Chemical Reactions**
  - When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
  - No matter what reaction or change in properties occurs, the total weight of the substances does not change. *(Boundary: Mass and weight are not distinguished at this grade level.)* (5-PS1-2)

### NJSSLS- Science CrossCutting Concepts:

- **Cause and Effect**
  - Cause and effect relationships are routinely identified and used to explain change. (5-PS1-4)

- **Scale, Proportion, and Quantity**
  - Natural objects exist from the very small to the immensely large. (5-PS1-1)
  - Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2),(5-PS1-3)

- **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**
  - Science assumes consistent patterns in natural systems. (5-PS1-2)
### Essential Questions**

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

- When two substances are mixed together, is something completely new and different always made?
- What happens to the mass of matter as it goes through its different forms (solid, liquid, gas)?
- What are the possible effects of mixing two or more different substances?

### Enduring Understandings & Practices

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

- Matter is a term that applies to all of the stuff around us and is made of particles that are too small to see.
- When substances are heated, cooled, or mixed the total weight before and after is always the same.
- Substances can be identified based on observable and measurable properties.
- Sometimes when two substances are mixed, each of the substances keeps its original properties and sometimes a new substance is formed.

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

- Develop a model to describe phenomena. (5-PS1-1)
- Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)
- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

### Prior Learning

**Grade 2**

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.
- A great variety of objects can be built up from a small set of pieces.
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

### Future Learning

**Grade 7**

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced out except when they happen to collide. In a solid, atoms are closely spaced and they vibrate in position but do not change relative locations.

Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

The changes of state that occur with variations and temperature or pressure can be described and predicted using these models of matter.

### 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**: Similar Substances - Students have been asked to help the local crime-fighting unit solve a fictional mystery. Students will use the Powder Test Kit created in their group exploration to identify powders and solve a mystery in Similar Substances. (Teacher's Notes)

Please click HERE to access our 2017 - 2018 K-5 Design Rubric.


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  
-HYPERLINK "https://sites.google.com/site/sciencephenomena/" #ProjectPhenomena                                                                                                                                                               |
| Questioning Opportunity     |                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                        |
| 1                           | Discover what matter is and the states of matter                                                                                                                                                                                                                                                                                                      | -Google Slides Unit Presentation  
-DE Reading: Review of matter  
-DE Interactive: What's The Matter?                                                                                                                                                                                                       |
| 2                           | Understand ways mass and matter are measured                                                                                                                                                                                                                                                                                                         | -Google Slides Unit Presentation  
-NJCTL Hands on experiment: The Mass of Air Lab                                                                                                                                                                                                                                                      |
| 3                           | Understand The Law of Conservation of Mass, understanding matter is neither created nor destroyed                                                                                                                                                                                         | -Google Slides Unit Presentation  
-DE Experiment: Will it Freeze?                                                                                                                                                                                                         |
| 4                           | Demonstrate that matter is neither created nor destroyed                                                                                                                                                                                                                                 | -DE Reading: No Loss, No Gain  
-DE Hands on experience: Changing States of Matter                                                                                                                                                                                                                                                      |
| 5                           | Demonstrate that matter is neither created nor destroyed                                                                                                                                                                                                                                 | -NJCTL Hands on experiment: Changing States of Matter Lab  
-DE reading: Shuttle Launch                                                                                                                                                                                                                                                                          |
| 6                           | Explain how matter is described and defined by observable properties                                                                                                                                                                                                                     | -Google Slides Unit Presentation  
-DE Reading: Physical Properties of Matter                                                                                                                                                                                                                                                           |
| 7                           | Students identify and compare properties such as mass, weight, color, texture, state and ability to sink or float in water, of a variety objects and materials.                                                                                                                                 | -DE Hands on experience: Properties of Matter                                                                                                                                                                                                                                                         |
| 8                           | Explain how different properties describe a substance based on synthesis of information from previous lesson                                                                                                                                                                              | -DE Writing piece: Constructed Response: Review of matter                                                                                                                                                                                                                                            |
| 9                           | Explore how substances mix and dissolve to create a solution                                                                                                                                                                                                                               | -Google Slides Unit Presentation  
-DE Video: Solutes and Solvents, Solutions  
-DE Interactive: Solutions                                                                                                                                                                                                                                                                          |
<p>| | | |</p>
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</table>
| 10 | Determine if you can visually tell the difference between soluble and insoluble substances | -NJCTL: Solutions Demonstration  
-DE Video: Solubility  

-Google Slides Unit Presentation  
-NJCTL: Conservation of Mass in Solutions Lab  
-Experiment on changes in matter: Changes in Matter, Not in Weight  


| 11 | Determine what happens to the mass of two substances when a solution is made | -DE video: Chemical Changes in Matter, Slow Chemical Changes in Matter  
-NJCTL: Conservation of Mass in Matter Lab  
-DE readings: Keep It In The Dark, A Special Day  
-DE Interactive: Things That Change  
-Mystery Science: What Do Fireworks, Rubber, and Silly Putty Have in Common?  


| 12 | Conservation of mass in chemical reactions | -DE video: Chemical Changes in Matter, Slow Chemical Changes in Matter  
-NJCTL: Conservation of Mass in Matter Lab  
-DE readings: Keep It In The Dark, A Special Day  
-DE Interactive: Things That Change  
-Mystery Science: What Do Fireworks, Rubber, and Silly Putty Have in Common?  


| 13 | Explore what happens in a chemical reaction when substances are mixed together | -NJCTL: Matter Inquiry Lab  
-Kitchen Chemistry  
-Mystery Science: What Would Happen If You Drank A Glass of Acid?  
-Defined STEM: Road Specialist: Chemical Process to Treat Icy Roads  


| 14 | Group Exploration | -Mystery Powders Experiment (overview)  
-Directions for Mystery Powder  
-Mystery Powders Student Sheet  
-Expected results (teacher copy)  


| 15 | Performance Assessment | Students will utilize Powder Test Kit designed in the Mystery Powder group exploration experience to identify powders in Similar Substances.  
Teacher’s Notes  
Student Design Portfolio  


| 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 Resources**

- **Material Properties**: The dangerous Androvax has crash-landed on Earth! Sabotage his escape plans by tricking him into building a space ship out of the wrong materials.
- **Time for Slime**: Students combine water and borax to create slime. Be sure to read and follow all of the cautions on the borax box label.
- **Bubble Burst!**: How can baking soda and vinegar burst a zip-lock bag?  
- **Flame Out**: A candle flame is actually a chemical reaction in action! Candle wax is one of the chemicals in the reaction.  
- **Oobleck**  
- **Evaporation and Condensation**: Britannica School  
- **StudyJams**: Physical and Chemical Changes of Matter  
- **Teach Engineering**: Browse for Additional Lessons, Activities, and Units  
- **Crash Course Science**: YouTube Video Channel for Kids
**NSTA Web Seminar: Teaching NGSS in Elementary School—Fifth Grade**

Carla Zembal-Saul, Professor of Science Education at Penn State University, Mary Starr, Executive Director of Michigan Mathematics and Science Centers Network, and Kathy Renfrew, K-5 Science Coordinator for VT Agency of Education, shared an overview of the NGSS for Fifth Grade level students. Strategies, such as Claims, Evidence and, Reasoning (CER) and Know, Learning, Evidence, Wondering and Science (KLEWS) were discussed. The bundling of performance expectations with a focus on scientific practices, disciplinary core ideas, and cross-cutting concepts was also presented as a strategy for pulling it all together.

View the resource collection.

**Using the NGSS Practices in the Elementary Grades**

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

**Teaching NGSS in K-5: Constructing Explanations from Evidence**

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

View the resource collection.

**NGSS Core Ideas: Matter and Its Interactions**

The presenter was Joe Krajcik from Michigan State University. The program featured strategies for teaching about physical science concepts that answer questions such as "How do particles combine to form the variety of matter one observes?" and "How do substances combine or change (react) to make new substances?" Dr. Krajcik began the presentation by defining disciplinary core ideas and discussing the value of using core ideas to build understanding across time. He also talked about the way disciplinary core ideas work together with the other components of NGSS: scientific and engineering practices and crosscutting concepts. Dr. Krajcik talked about the disciplinary core ideas for PS1 and shared examples of student work. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

Visit the resource collection.

**Bozeman Science**

## UNIT 4

### Unit 4 - Matter & Energy in Organisms & Ecosystems

<table>
<thead>
<tr>
<th>Grade:</th>
<th>5th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain:</td>
<td>Physical /Life Science</td>
</tr>
<tr>
<td>Suggested Pacing:</td>
<td>20 Days</td>
</tr>
<tr>
<td>Discovery TechBook Unit:</td>
<td>Energy for Humans and Other Living Things</td>
</tr>
</tbody>
</table>

### NJSSLS- Science Performance Expectations:

- **5-PS3: Energy**
  - Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. (5-PS3-1)

- **5-LS1: From Molecules to Organisms: Structures and Processes**
  - Support an argument that plants get the materials they need for growth chiefly from air and water. (5-LS1-1)

### NJSSLS- Science Disciplinary Core Ideas:

- **PS3.D: Energy in Chemical Processes and Everyday Life**
  - 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). (5-PS3-1)

- **LS1.C: Organization for Matter and Energy Flow in Organisms**
  - Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)
  - Plants acquire their material for growth chiefly from air and water. (5-LS1-1)

### NJSSLS- Science CrossCutting Concepts:

- **Energy and Matter**
  - Matter is transported into, out of, and within systems. (5-LS1-1)
  - Energy can be transferred in various ways and between objects. (5-PS3-1)

### Essential Questions**

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

- **How and why do organisms interact with their environment and what are the effects of these interactions?**
- **How do organisms interact with the living and nonliving environments to obtain matter and energy?**
- **How is energy transferred and conserved?**
- **How do food and fuel provide energy?**
- **If energy is conserved, why do people say it is produced or used?**
- **How do organisms live, grow, respond to their environment, and reproduce?**
- **How do organisms obtain and use the matter and energy they need to live and grow?**
### Enduring Understandings & Practices

<table>
<thead>
<tr>
<th>By the end of this unit, students will understand:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● How animals get energy from plants and other animals.</td>
</tr>
<tr>
<td>● The interdependent nature of food webs.</td>
</tr>
<tr>
<td>● How animals acquire oxygen in different ways.</td>
</tr>
<tr>
<td>● How animals use special actions and body parts to get the food they need.</td>
</tr>
<tr>
<td>● Energy can change forms within a system.</td>
</tr>
<tr>
<td>● Many systems convert energy to heat or motion.</td>
</tr>
<tr>
<td>● Energy changes form every time it passes to a different organism in an ecosystem.</td>
</tr>
<tr>
<td>● The progression in the food chain of several common foods.</td>
</tr>
<tr>
<td>● The basic needs of plants.</td>
</tr>
<tr>
<td>● The systems plants have to transport water and nutrients.</td>
</tr>
<tr>
<td>● The role of photosynthesis in nature.</td>
</tr>
<tr>
<td>By the end of this unit, students will be able to:</td>
</tr>
<tr>
<td>● Use models to describe phenomena. (5-PS3-1)</td>
</tr>
<tr>
<td>● Support an argument with evidence, data, or a model. (5-LS1-1)</td>
</tr>
<tr>
<td>● Science explanations describe the mechanisms for natural events. (5-LS2-1)</td>
</tr>
</tbody>
</table>

### Prior Learning

#### Kindergarten
- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

#### Grade 2
- Plants depend on water and light to grow.
- Plants depend on animals for pollination or to move their seeds around.

#### Grade 4
- Living things affect the physical characteristics of their regions.

### Future Learning

#### Grade 6:
- Organisms and populations of organisms are dependent on their environmental interactions with other living and nonliving things.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources.
- Access to food, water, oxygen, or other resources constrain organisms’ growth and reproduction.
- Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms.
- Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.
- Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments.
- Decomposers recycle nutrients from dead plant or animal matter back to the water in aquatic environments.
- The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
- Ecosystems are dynamic in nature and their characteristics can vary over time.
- Small changes in one part of an ecosystem might cause large changes in another part.
Grade 7

- Photosynthesis has a role in the cycling of matter and flow of energy into and out of organisms.
- The flow of energy and cycling of matter can be traced.
- 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.
- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen.
- Sugars produced by plants can be used immediately or stored for growth or later use.

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).

Assessment

End-of-Unit Performance Assessment:
In this Performance Assessment, students will demonstrate their knowledge of unit concepts by creating an image web and completing a writing task. Students will identify the needs of living things and trace each need back to a natural origin. The visual aid will show pictorial representations of the links while the writing task will fully explain the link between origin and point of consumption.

Please click HERE to access our 2017 - 2018 K-5 Design Rubric.

Suggested Hands-On Activities / Classroom Inquiries:
How Does Your Garden Grow/Examining Plant Growth/Creating and Comparing Food Chains/Chomp Nibble Grow Grow Grow/Gulf of Mexico Game

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.
<table>
<thead>
<tr>
<th>Experience</th>
<th>Objective/Desired Outcome</th>
<th>Classwork Resources</th>
</tr>
</thead>
</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  
HYPERLINK “https://sites.google.com/site/sciencephenomena/” #ProjectPhenomena |
| 1 | Understanding Energy | -**DE:** Engage: Stimulate Interest  
-DE: Engage Videos: Energy Flow(Video)  
-Google Slides Unit Presentation |
| 2 | Identify the Basic Needs and Structure of Plants | -**DE** Engage: Could Plants Grow on the Moon? (Article) (Spanish Version)  
-DE Explore: What Plants Need to Live(Video), Plants Have Needs(Video), Leaves, Roots and Trunks(Video), Stem(Video), Roots(Video), Leaves(Video), Water(Video)  
-DE Explain: Basic Needs(Interactive)  
-Google Slides Unit Presentation |
| 3 | Investigate the Ways that Plants Create Energy | -**DE** Engage: Plants Make Their Own Food(Video)  
-DE Explore: Food: Energy from the Sun(Video), The Sun, Light, and Photosynthesis(Video), Leaves and Photosynthesis(Video), How Plants Make Food(Video), A Sweet Discovery: How a Plant Makes Food(Video)  
-Google Slides Unit Presentation  
-Mystery Science: What Do Plants Eat? |
| 4 | Explore Energy Use in Plants | -**DE** Explain: Virtual Lab: How Does Your Garden Grow  
-Google Slides Unit Presentation  
-Examining Plant Growth Lab(Report) (Teacher Led) (Lab requires live plants so we suggest a teacher-led experience) |
| 5 | Check for Understanding | -**DE** Explain: Basic Needs - Constructed Response  
-Defined STEM: Business of Farming |
| 6 | Identify the Basic Needs and Structure of Animals | -**DE** Engage: Activate Prior Knowledge  
-DE Explore: Scientific Explanation, Animals and Oxygen(Article), Importance of Oxygen(Video), Getting Oxygen(Video), How Do Fish Breath(Video), Gas Exchange in Animals(Video), The Oxygen Cycle(Video)  
-Google Slides Unit Presentation |
| 7 | Investigate the Ways that Animals Use Energy | -DE Explore: Food and Energy(Article), How Do Animals Get Food?(Video), The Predators: Their Adaptations for Hunting(Video), Herbivores(Video), Carnivores(Video), Omnivores(Video)  
-DE Elaborate: Jeff Corwin: Mammals Around the World(Video)  
-Explore: Food and Energy(Article), How Do Animals Get Food?(Video), The Predators: Their Adaptations for Hunting(Video), Herbivores(Video), Carnivores(Video), Omnivores(Video)  
-Elaborate: Jeff Corwin: Mammals Around the World(Video) |
| 8 | Check for Understanding | -DE Evaluate Session 8: Board Builder |
| 9 | Uncover Energy Flow through Ecosystems | -DE Explore: All Living Things Need Food to Survive, The Human Body - An Incredible Machine  
-DE Explore: Food Chain, Food Chain Mystery, Food Web  
-DE Explain(Hands On Activity): Creating and Comparing Food Chains  
-Hands on game: PBS Chomp, Nibble Grow Grow Grow  
-Explore: All Living Things Need Food to Survive, The Human Body - An Incredible Machine  
-DE Explore: Food Chain, Food Chain Mystery, Food Web  
-Hands on game: PBS Chomp, Nibble Grow Grow Grow  
-Mystery Science: Why Would a Hawk Move To NYC? |
| 10 | Examine Roles of Organisms in the Flow of Energy | -DE Elaborate: Overview of Mammals, Carnivores, Herbivores and Omnivores and Their Role as Consumers in the Food Chain or Web, How Plants Make Food(Video), Food: Energy from the Sun(Video)  
-Explore: Overview of Mammals, Carnivores, Herbivores and Omnivores and Their Role as Consumers in the Food Chain or Web, How Plants Make Food(Video), Food: Energy from the Sun(Video)  
-DE Evaluate: Energy in Systems - Constructed Response  
-Explore: Overview of Mammals, Carnivores, Herbivores and Omnivores and Their Role as Consumers in the Food Chain or Web, How Plants Make Food(Video), Food: Energy from the Sun(Video)  
-Hands on game: PBS Chomp, Nibble Grow Grow Grow  
-Mystery Science: Where Do Fallen Leaves Go?  
-Explore: Overview of Mammals, Carnivores, Herbivores and Omnivores and Their Role as Consumers in the Food Chain or Web, How Plants Make Food(Video), Food: Energy from the Sun(Video)  
-DE Evaluate: Energy in Systems - Constructed Response  
-Mystery Science: Where Do Fallen Leaves Go? |
| 11 | Check for Understanding | -DE Evaluate Session 8: Board Builder  
-Hands on experiment/game: Gulf of Mexico Game (Pages 13-23 of packet)  
-Defined STEM: Ecologist: Invasive Species |
| 12 | Performance Assessment | -Unit 4 PBA - The Needs Of Living Things |

**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 Resources

- **Bottle Biology Terrarium**: Students will create a terrarium, make observations of the terrarium, then develop a model to explain how matter transfers within the ecosystem. This resource describes the process of creating a terrarium (which will serve as the phenomena that the students observe), but does not include specific lesson details or instructional strategies.

- **Where the Bison Roam eTrip**: Meet Rosie, a young bison alone in a Yellowstone winter, and learn how she is affected by the park’s thermal areas. How will these sites influence Rosie’s behavior or sway her migration choices?

- **Biodomes Engineering Design Project**: This activity is a culmination of a 16 day unit of study where students explore the biosphere's environments and ecosystems. In this final activity, students apply what they learned about plants, animals, and decomposers to design and create a model biodome. Engaging in the engineering design process, students construct a closed (system) environment containing plants and animals existing in equilibrium. Provided with a variety of materials (constraints), teams of students will use their imagination and culminating knowledge to design a biodome structure following the criteria of the activity that models how plants, insects, and decomposers work together in a system. (The activity can
Science Grade 5

be conducted as a structured or open-ended design. It is recommended to allow students the opportunity to be true engineers and follow the open-ended design.

- **Climate Kids:** NASA’s Eyes on the Earth
- **Ecosystem Challenge:** In this PBS Learning Media lesson, students model the interactions between the plants and animals in an ecosystem by playing a collection of online games.
- **Ecosystem Explorer-Earth A New Wild:** Inspired by content from the upcoming PBS series *EARTH A New Wild*, the Ecosystem Explorer is a collection of videos, games, and infographics designed to take students deep into the ecosystems of three thrilling animals: vultures, wolves, and sharks.
- **Antarctic Food Web Game:** Players must position the names of producers and consumers in the correct places in a diagram. The completed diagram reveals how energy flows through an Antarctic ecosystem and the relationships between predators and prey.
- **StudyJams: Ecosystems**
- **StudyJams: Aquatic Ecosystems**
- **StudyJams: Changes in Ecosystems**
- **Teach Engineering:** Browse for Additional Lessons, Activities, and Units
- **Crash Course Science:** YouTube Video Channel for Kids

### Teacher Professional Learning Resources

**Connections Between Practices in NGSS, Common Core Math, and Common Core ELA**
The presenter was Sarah Michaels from Clark University. In this seminar Dr. Michaels talked about connecting the scientific and engineering practices described in A Framework for K–12 Science Education with the Common Core State Standards in Mathematics and English Language Arts.

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

Visit the resource collection.

**NGSS Core Ideas: Energy**
The presenter was Jeff Nordine of the San Antonio Children's Museum. Ramon Lopez from the University of Texas at Arlington provided supporting remarks. The program featured strategies for teaching about physical science concepts that answer questions such as "How is energy transferred between objects or systems?" and "What is meant by conservation of energy?" Dr. Nordine began the presentation by talking about the role of disciplinary core ideas within NGSS and the importance of energy as a core idea as well as a crosscutting concept. He then shared physicist Richard Feynman's definition of energy and related it to strategies for teaching about energy. Dr. Nordine talked about the elements of the energy core idea and discussed common student preconceptions. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

Visit the resource collection.

**NGSS Core Ideas: Ecosystems: Interactions, Energy, and Dynamics**
The presenters were Andy Anderson and Jennifer Doherty of Michigan State University. This was the ninth web seminar in a series focused on the disciplinary core ideas that are part of the Next Generation Science Standards (NGSS). The program featured strategies for teaching about life science concepts that answer questions such as "How do organisms interact with the living and nonliving environments to obtain matter and energy?" and "How do matter and
Dr. Anderson and Dr. Doherty began the presentation by discussing the two main strands of the ecosystems disciplinary core idea: community ecology and ecosystem science. They talked about common student preconceptions and strategies for addressing them. Next, Dr. Anderson and Dr. Doherty shared learning progressions for this core idea, showing how student understanding builds from elementary through high school. Last, the presenters described approaches for teaching about ecosystems and shared resources to use with students. Participants had the opportunity to submit their questions and comments in the chat.

Visit the resource collection.

Bozeman Science

## UNIT 5

### Unit 5 - TransDisciplinary: Ecosystem Dynamics

<table>
<thead>
<tr>
<th>Grade:</th>
<th>5th</th>
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<tbody>
<tr>
<td>Pacing:</td>
<td>Marking Period 3</td>
</tr>
</tbody>
</table>

#### Domain: Physical Science/Life Science

| Discovery TechBook Unit: | Energy for Humans and Other Living Things |

### NJSLS- Science Performance Expectations:

- **5-PS3: Energy**
  - Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. (5-PS3-1)
- **5-LS1: From Molecules to Organisms: Structures and Processes**
  - Support an argument that plants get the materials they need for growth chiefly from air and water. (5-LS1-1)
- **5-LS2: Ecosystems: Interactions, Energy, and Dynamics**
  - Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. (5-LS2-1)
- **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.D: Energy in Chemical Processes and Everyday Life**
  - 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). (5-PS3-1)
- **LS2.A: Interdependent Relationships in Ecosystems**
  - The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)
- **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**
  - Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

### NJSLS- Science CrossCutting Concepts:

- **Systems and System Models:**
  - A system can be described in terms of its components and their interactions. (5-LS2-1)
- **Energy and Matter:**
  - Matter is transported into, out of, and within systems. (5-LS1-1)
  - Energy can be transferred in various ways and between objects. (5-PS3-1)
**NJSLS - Technology:**

- **8.1 Educational Technology**
  - Graph data using a spreadsheet, analyze and produce a report that explains the analysis of the data. (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)

**Overarching Local/Global Problem:**

Reports show that currently 905 animal species are extinct, that number grew from 784 in 2006. In addition, 16,928 animal species are listed as threatened to be extinct. If we look even further into the data, we will find that the North American region leads all others with 256 extinct species. Awareness has been raised but the hard work of helping these species is never ending and requires great effort.

**Essential Questions**

*The questions below are suggested EQs to guide the unit. NJSLS-Science was composed for students to drive learning. Afford children the opportunity to ask the question and define potential problems as the unit progresses.*

- What makes up a balanced or healthy ecosystem?
- How are the parts of an ecosystem interdependent?
- What can happen if an ecosystem becomes unbalanced?
- How does energy flow through an ecosystem?

**Enduring Understandings & Practices**

By the end of this unit, students will understand:

- The sun is the origin of all energy used by living things.
- Energy is passed from one living thing to another through feeding relationships.
- Balanced ecosystems are vital to support life.
- The concepts of interdependence and interactions in an ecosystem.
- The world consists of different land and aquatic ecosystems.
- Land ecosystems differ from each other based on climate which consists of precipitation and temperature.
- Ecosystems can change over time.
- The makeup of a balanced or healthy ecosystem consists of a variety of criteria.
- Humans can have both positive and negative effects on ecosystem balance.

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

- Use models to describe phenomena. (5-PS3-1)
- Develop a model to describe phenomena. (5-LS2-1)
- Support an argument with evidence, data, or a model. (5-LS1-1)
- Science explanations describe the mechanisms for natural events. (5-LS2-1)
## Prior Learning

### Kindergarten
- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

### Grade 2
- Plants depend on water and light to grow.
- Plants depend on animals for pollination or to move their seeds around.

### Grade 4
- Living things affect the physical characteristics of their regions.

## Future Learning

### Grade 6:
- Organisms and populations of organisms are dependent on their environmental interactions with other living and nonliving things.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources.
- Access to food, water, oxygen, or other resources constrain organisms' growth and reproduction.
- Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms.
- Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.
- Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments.
- Decomposers recycle nutrients from dead plant or animal matter back to the water in aquatic environments.
- The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
- Ecosystems are dynamic in nature and their characteristics can vary over time.
- Small changes in one part of an ecosystem might cause large changes in another part.

### Grade 7
- Photosynthesis has a role in the cycling of matter and flow of energy into and out of organisms.
- The flow of energy and cycling of matter can be traced.
- 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.
- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen.
- Sugars produced by plants can be used immediately or stored for growth or later use.

## 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:** Endangered Species Habitat Design Challenge - In this performance assessment, students will plan an animal enclosure that will aid in the survival of endangered species, ensuring that the links in the energy food chain stay intact and allow future generations to enjoy these animals as well.

*Please click [HERE](#) to access our 2017 - 2018 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](#).*

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

*(Pleases 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>
</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 |
| **1** | TLW develop an understanding of the global problem and design challenge through close reading of the background statement and a group discussion. | Introduce Background Statement and Design Challenge.  
Students will receive their [Design Portfolio](#) which contains many of the assignments for the unit. Please have students make note of the three (3) criteria for the final project.  
Three criteria for the final submission:  
- Model/Sketch of Endangered Species Habitat  
- Written Rationale with Evidence  
- Visual of Food Chain/Food Web within Design Challenge Habitat |
<p>| | | |</p>
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|   | It is recommended that the criteria be revisited periodically to make sure that there is ongoing progress throughout the unit toward the final product.  
-Read aloud: *A River Ran Wild* |   |
| 2 | TLW gain insight into the design challenge by making real world connections. | Ivan the Gorilla - Video  
Meet Ivan: Author Interview - NPR Text and Audio  
Video and text shows an example of a real life context in which a gorilla is housed in a small enclosure, providing information useful to their challenge solution. |
| 3 | TLW develop an understanding of data analysis by analyzing climates and precipitation in various ecosystems. | Math Activity: Analyzing and graphing climate using Investigation from Chapter 4 Lesson 2 in Houghton Mifflin Science. B10 & B11  
Students will explore ecosystems by graphing and analyzing data. |
| 4 | TLW investigate the different land ecosystems and their characteristics. | Students use the web resource linked below to collect information on the different terrestrial ecosystems.  
**EXPLORE** - DE TechBook  
[**Ecosystems** - BrainPop Video](#)  
Biodiversity - Bill Nye  
I Spy an Ecosystem - Text  
Ecosystems - Web Resource  
Biomes - Text  
Taiga - BrainPop Video  
Tundra - BrainPop Video  
Deserts - Brainpop Video  
Tropical Rainforest - BrainPop Video |
| 5 | TLW investigate the different water ecosystems and their characteristics. | Students use the web resource linked below to collect information on the different aquatic ecosystems.  
**ENGAGE & EXPLORE** - DE TechBook  
[**Underwater World** - BrainPop Video](#)  
[**The Everglades** - BrainPop Video](#)  
Defined STEM: Marine Biologist: Adaptations of Marine Creatures |
| 6 | TLW brainstorm possible biome options to focus on for Endangered Species Habitat Challenge. | Students will reflect on the ecosystems and biomes studied in order to narrow their focus. They will need to plan early to gather information for the design challenge.  
Optional - Submit 3 choices in Google Form or Canvas. |
| 7 | TLW explore the parts of an ecosystem in order to understand interactions and dependencies within an ecosystem. | **ENGAGE** - Activate Prior Knowledge - DE Techbook  
Students will begin to explore how organisms interact with living and nonliving environments to obtain matter and energy? |
| 8 | TLW strengthen their own knowledge of ecosystem balance and interdependence. | **EXPLORE 1** - DE TechBook  
Students will explore two of our essential questions:  
What makes up a balanced or healthy ecosystem?  
How are the parts of an ecosystem interdependent? |
| 9 | TLW demonstrate their own knowledge of ecosystem balance and interdependence. | **EXPLAIN 1** - DE TechBook  
Students will explain their findings based on collected evidence from the previous experience. |
| 10 | TLW select one biome for the design challenge and explore endangered species within selected biome. | **Endangered Species** - DE TechBook Video  
Optional - Submit biome and endangered species choices in Google Form or Canvas. |
| 11 | TLW explore the components of a food chain. |  
**Food Chains** - BrainPop Video  
**Producers and Consumers** - DE TechBook Video  
**Decomposers** - DE TechBook Video  
Students will explore the individual components that make up a food chain and allow energy to flow through an ecosystem. |
| 12 | TLW analyze the flow of energy through an ecosystem and what happens when an ecosystem is unbalanced. | **EXPLORE 2** - DE Techbook  
**Energy Pyramid** - BrainPop Video  
**Food Chain Game**  
**Food Web Game**  
**Chomp Nibble Grow Grow Grow** - Video  
**Chomp Nibble Grow Grow Grow** - Activity  
Students will explore two of our essential questions:  
What can happen if an ecosystem becomes unbalanced?  
How does energy flow through an ecosystem? |
<table>
<thead>
<tr>
<th>#</th>
<th>TLW Demonstrate Their Knowledge of Energy Flow and Unbalanced Ecosystems.</th>
<th>Explain 2 - DE TechBook</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Students will explain their findings based on collected evidence from the previous experience.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>#</th>
<th>TLW Select Their Endangered Species for the Design Challenge.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Students should now be able to select their endangered species based on the material covered. They will continue to gain more information in the following lessons but they should now have a focus for their animal and the difficulties that it faces.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>TLW Develop an Understanding of Habitats and Niches.</th>
<th>Habits - BrainPop Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Students should create a snapshot of their backyard ecosystem, including their own niche and impact. Their snapshot could be a description, drawing, or even an actual photo.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Students will use the morphological chart to brainstorm solution ideas by developing criteria in a number of different categories. (i.e.-size, world location, natural vs zoo, etc.)</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Using this time to have students begin to think about materials that they will need in preparation for the building phase that will take place in the future.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>TLW Brainstorm Possible Habitat Solutions.</th>
<th>Math Activity: HMH Science - B.5 Math Skills - Read a Double Line Graph pg B57</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>TLW Develop an Understanding of Causes of Change in a Population of a Species.</th>
<th>Invasive Species - Web Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Students will explore how population size is affected by alien species and natural selection.</td>
<td>Attack of the Lionfish - Newsela Article</td>
</tr>
<tr>
<td>18</td>
<td>TLW determine the habitat design solution that they will create from possible variations.</td>
<td>Students should arrive at a decision for the design solution that they will bring to conceptualization. They will complete their rationale and initial sketches for this design in their design portfolio.</td>
</tr>
<tr>
<td>19</td>
<td>TLW compile research and data to support the rationale for choices made during the design process.</td>
<td>The final project includes the completed model/sketch as well as a rationale for their endangered species and design choices. Students will reflect on their choices made and the evidence that supports their choices in preparation for their final writing piece.</td>
</tr>
</tbody>
</table>
| 20 | TLW develop an understanding of the effects humans have on an ecosystem. | **ELABORATE** - DE TechBook  
**The Lorax** - Web Resource  
**5 Human Impact on the Environment** - Crash Course Ecology  
SS Text: Biography: Marjory Stoneman Douglas pg 35  
After gaining a deeper understanding of human impact, students will work in small groups to prepare a 30-second public service announcement about human impact on their ecosystems. |
| 21 | TLW demonstrate understandings gained through unit instruction. | **EVALUATE** - DE Techbook  
Defined STEM: **Efficiency Expert: Zoos** |
| 22 | TLW plan their design challenge solution. | Students will use the remainder of the design portfolio to plan their design challenge habitat. |
| 23 | TLW strengthen their argument by citing factual evidence to support their rationale for decisions. | Students will be given additional time to strengthen their writing and take the piece through the stages of the writing process. |
| 24 | Design Challenge  
TLW develop the ability to summarize information and previous learning in order to create a habitat that will protect an endangered species so that it may grow in population size and thrive once again. | Students are given time to begin creating their endangered species habitat based on their understanding of the interactions of within an ecosystem and the effects of human beings.  
Students should be creating a hands on/visual representation. This can be built physically or digitally. |
Three criteria for the final submission:
- Model/Sketch of Endangered Species Habitat
- Written Rationale with Evidence
- Visual of Food Chain/Food Web within Design Challenge Habitat

| 25 | Present and Peer Review | Students present their design challenge. Peers ask questions and offer feedback. Optional: Pair with a class in another 5th grade class in Edison to share across the district. |
| 26 (Approximately three days) | Improve | Students are given time to revise their projects and finalize their plans based on the feedback of their peers. |

### Additional Resources

- **Bottle Biology Terrarium**: Students will create a terrarium, make observations of the terrarium, then develop a model to explain how matter transfers within the ecosystem. This resource describes the process of creating a terrarium (which will serve as the phenomena that the students observe), but does not include specific lesson details or instructional strategies.
- **Where the Bison Roam eTrip**: Meet Rosie, a young bison alone in a Yellowstone winter, and learn how she is affected by the park’s thermal areas. How will these sites influence Rosie’s behavior or sway her migration choices?
- **Biodomes Engineering Design Project**: This activity is a culmination of a 16 day unit of study where students explore the biosphere’s environments and ecosystems. In this final activity, students apply what they learned about plants, animals, and decomposers to design and create a model biodome. Engaging in the engineering design process, students construct a closed (system) environment containing plants and animals existing in equilibrium. Provided with a variety of materials (constraints), teams of students will use their imagination and culminating knowledge to design a biodome structure following the criteria of the activity that models how plants, insects, and decomposers work together in a system. (The activity can be conducted as a structured or open-ended design. It is recommended to allow students the opportunity to be true engineers and follow the open-ended design.)
- **Climate Kids**: NASA’s Eyes on the Earth
- **Ecosystem Challenge**: In this PBS Learning Media lesson, students model the interactions between the plants and animals in an ecosystem by playing a collection of online games.
- **Ecosystem Explorer-Earth A New Wild**: Inspired by content from the upcoming PBS series *EARTH A New Wild*, the Ecosystem Explorer is a collection of videos, games, and infographics designed to take students deep into the ecosystems of three thrilling animals: vultures, wolves, and sharks.
- **Antarctic Food Web Game**: Players must position the names of producers and consumers in the correct places in a diagram. The completed diagram reveals how energy flows through an Antarctic ecosystem and the relationships between predators and prey.
- **StudyJams: Ecosystems**
- **StudyJams: Aquatic Ecosystems**
- **StudyJams: Changes in Ecosystems**
- **Teach Engineering**: Browse for Additional Lessons, Activities, and Units
- **Crash Course Science**: YouTube Video Channel for Kids
**Connections Between Practices in NGSS, Common Core Math, and Common Core ELA**

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

**Engineering Design as a Core Idea**

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

Visit the resource collection.

**NGSS Core Ideas: Energy**

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

Dr. Nordine began the presentation by talking about the role of disciplinary core ideas within NGSS and the importance of energy as a core idea as well as a crosscutting concept. He then shared physicist Richard Feynman's definition of energy and related it to strategies for teaching about energy. Dr. Nordine talked about the elements of the energy core idea and discussed common student preconceptions. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

Visit the resource collection.

**NGSS Core Ideas: Ecosystems: Interactions, Energy, and Dynamics**

The presenters were Andy Anderson and Jennifer Doherty of Michigan State University. This was the ninth web seminar in a series focused on the disciplinary core ideas that are part of the Next Generation Science Standards (NGSS). The program featured strategies for teaching about life science concepts that answer questions such as "How do organisms interact with the living and nonliving environments to obtain matter and energy?" and "How do matter and energy move through an ecosystem?"

Dr. Anderson and Dr. Doherty began the presentation by discussing the two main strands of the ecosystems disciplinary core idea: community ecology and ecosystem science. They talked about common student preconceptions and strategies for addressing them. Next, Dr. Anderson and Dr. Doherty shared learning progressions for this core idea, showing how student understanding builds from elementary through high school. Last, the presenters described approaches for teaching about ecosystems and shared resources to use with students. Participants had the opportunity to submit their questions and comments in the chat.

Visit the resource collection.

**Bozeman Science**

## UNIT 6

### Unit 6 - TransDisciplinary: Community of Tomorrow Design Challenge

<table>
<thead>
<tr>
<th>Grade:</th>
<th>5th</th>
<th>Pacing:</th>
<th>Marking Period 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain:</td>
<td>Earth &amp; Space Science</td>
<td>Discovery TechBook Unit:</td>
<td>Various</td>
</tr>
</tbody>
</table>

### NJSLSS- Science Performance Expectations:

- **5-ESS2: Earth’s Systems**
  - Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (5-ESS2-1)
  - Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. (5-ESS2-2)

- **5-ESS3: Earth and Human Activity**
  - Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. (5-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)

### NJSLSS- Science Disciplinary Core Ideas:

- **ESS3.C: Human Impacts on Earth Systems**
  - 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. (5-ESS3-1)

- **ESS2.A: Earth Materials and Systems**
  - 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. (5-ESS2-1)

- **ESS2.C: The Roles of Water in Earth’s Surface Processes**
  - Nearly all of Earth’s available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

### NJSLSS- Science CrossCutting Concepts:

- **Systems and System Models:**
  - A system can be described in terms of its components and their interactions. (5-ESS3-1)

- **Science Addresses Questions About the Natural and Material World:**
  - Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)

- **Scale, Proportion, and Quantity:**
  - Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)

### NJSLSS - Technology:

- **8.1 Educational Technology**
<table>
<thead>
<tr>
<th>8.2 Technology Education, Engineering, Design and Computational Thinking - Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Compare and contrast how products made in nature differ from products that are human made in how they are produced and used. (8.2.5.A.1)</td>
</tr>
<tr>
<td>● Investigate and present factors that influence the development and function of a product and a system. (8.2.5.A.2)</td>
</tr>
<tr>
<td>● Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints. (8.2.5.A.3)</td>
</tr>
<tr>
<td>● Compare and contrast how technologies have changed over time due to human needs and economic, political and/or cultural influences. (8.2.5.A.4)</td>
</tr>
<tr>
<td>● Identify how improvement in the understanding of materials science impacts technologies. (8.2.5.A.5)</td>
</tr>
</tbody>
</table>

Overarching Local/Global Problem:

Today, more and more communities are facing overcrowding. From the local level of small towns to the large level of whole countries, the issue of more people occupying land and needing resources is impacting our environment. Many scientists fear we are reaching dangerous levels of overcrowding and need to begin thinking of ways to preserve our limited resources.

Essential Questions

**The questions below are suggested EQs to guide the unit. NJSLS-Science was composed for students to drive learning. Afford children the opportunity to ask the question and define potential problems as the unit progresses.**

- What are the various human impacts on Earth’s systems?
- In what ways do Earth’s systems and raw materials come together to sustain life?
- How is Earth’s surface water distributed and what roles does it play?

Enduring Understandings & Practices

By the end of this unit, students will understand:
- The impact of humans on Earth’s systems.
- The various systems of Earth and how they interact.
- Water and freshwater are distributed in a variety of reservoirs.
- Communities use science to protect the Earth’s resources and the environment.

By the end of this unit, students will be able to:
- Develop a model using an example to describe a scientific principle. (5-ESS2-1)
- Describe and graph quantities to address scientific questions. (5-ESS2-2)
- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)
### Prior Learning

**Grade 2**
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.
- Wind and water can change the shape of the land.

**Grade 3**
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
- Climate describes a range of an area’s typical weather conditions and the extent to which those conditions vary over years.

**Grade 4**
- 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.

### Future Learning

**Grade 6**
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Global movements of water and its changes in form are propelled by sunlight and gravity.
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations.
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. Because these patterns are so complex, weather can only be predicted probabilistically.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

**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.
- Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations.

**Grade 8**
- 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:** Community of Tomorrow Design Challenge - With the knowledge of the geosphere, biosphere, hydrosphere, and atmosphere gained throughout the unit, students are tasked with creating a community for future populations in non-traditional places (ie. create their own island, on a mountain top, underground, floating in the air, etc.).

Please click HERE to access our 2017 - 2018 K-5 Design Rubric.

**Hands-On Activities / Classroom Inquiries:** Scale Model of Earth, Turtle Diary, Sand Dune Erosion, Canyons/Streaming Slope, Creating New Land, Model of Earth’s Atmosphere, Land Plan Challenge

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

*(Pleases 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</td>
<td>To spark curiosity and amplify engagement, students should formulate their own</td>
<td>-KWHLAQ: Organizer</td>
</tr>
<tr>
<td>Opportunity</td>
<td>questions regarding the phenomena/topic of the unit. They should then be</td>
<td>-KWHLAQ: Google Slides</td>
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<tr>
<td></td>
<td>afforded an opportunity to investigate them (and others that emerge) throughout</td>
<td>-Science Questioning Graphic Organizer</td>
</tr>
<tr>
<td></td>
<td>the unit in order to heighten authenticity and deepen their knowledge and</td>
<td>-QFT: Formulating effective questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Ideas For Phenomena To Question:</td>
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<tr>
<td></td>
<td></td>
<td>NGSS Phenomena</td>
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<tr>
<td></td>
<td>Understanding. Teachers may use these questions as a pre-assessment and as a means to guide future learning experiences.</td>
<td>#ProjectPhenomena</td>
</tr>
<tr>
<td>1</td>
<td>TLWD an understanding of the design challenge problem by observing a real world example and establishing a goal for learning.</td>
<td>Introduce Background Statement and Design Challenge.</td>
</tr>
<tr>
<td>2</td>
<td>TLWD an understanding of real world application of their design challenge by seeing how this applies in Dubai.</td>
<td>Video on Dubai Island Video shows an example of a real life context to when scientists built a new land formation, similar to their design challenge project. This lesson provides context and background.</td>
</tr>
<tr>
<td>3</td>
<td>TLWD an understanding of the makeup of the Earth by discovering elements of the Geosphere.</td>
<td>Text: Earth’s Physical Characteristics (TechBook) Follow up writing activity: Formations of Landforms (TechBook) Video: Crash Course Students will explore the physical characteristics of Earth using the text, video, and follow up writing activity.</td>
</tr>
<tr>
<td>4</td>
<td>Layers of the Earth TLWD an understanding of the Earth’s makeup by creating a scaled representation of the Earth and its layers.</td>
<td>Interactive Layers of the Earth Math project: Scale model of Earth - Students represent either as drawing, clay, Google Drawing, etc. with focus on math equations and accurate scaled ratios. Students use the web resource linked above to gain an understanding of the layers of the earth. Students then create a scaled drawing. Drawings can be done in various ways, some examples are listed above.</td>
</tr>
<tr>
<td>5</td>
<td>Layers of the Earth TLWD an understanding of the Earth’s makeup by creating a scaled representation of the Earth and its layers.</td>
<td>Model of layers project continued. Students continue on their projects from the previous day.</td>
</tr>
<tr>
<td>6</td>
<td>Soil/Sediment TLWD an understanding of the Earth’s soil by completing an investigation.</td>
<td>Students conduct an experiment based on soil and sediment. There are two options below, a virtual and a hands on. Based on time, availability of resources, etc., students can conduct either the virtual or hands on experiment. Virtual Experiment: Soil/Sediments (Turtle Diary) Hands on Experiment: Soil from various locations and observe at immediate, 10 minutes, an hour, next day</td>
</tr>
<tr>
<td>7</td>
<td>Erosion/Deposition</td>
<td>Video: • Bill Nye Erosion • Beach Erosion Lab Video</td>
</tr>
<tr>
<td>Page</td>
<td>Activity</td>
<td>Text</td>
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<tr>
<td>8</td>
<td>Sand Dune Erosion</td>
<td>Sandy Hook Article</td>
</tr>
<tr>
<td>9</td>
<td>Sand Shifter</td>
<td>Defined STEM: Erosion Management Specialist</td>
</tr>
<tr>
<td>10</td>
<td>Sand Shifter</td>
<td>Techbook exploration</td>
</tr>
<tr>
<td>11</td>
<td>Canyons</td>
<td>Techbook article: Volcanoes: Fast Changes to The Land</td>
</tr>
<tr>
<td>12</td>
<td>Canyons</td>
<td>Techbook Hands on Experiment:</td>
</tr>
<tr>
<td>13</td>
<td>Canyons</td>
<td>BrainPop video:</td>
</tr>
</tbody>
</table>

**Science Grade 5**

- **Activity:** Sand Dune Erosion
- **Text:** Sandy Hook Article
- **Activity:** Sand Dune Erosion
- **Text:** Defined STEM: Erosion Management Specialist
- **Activity:** Sand Dune Erosion
- **Text:** Techbook exploration
- **Activity:** Sand Dune Erosion
- **Text:** Techbook article: Volcanoes: Fast Changes to The Land
- **Activity:** Sand Dune Erosion
- **Text:** Techbook Hands on Experiment:
- **Activity:** Sand Dune Erosion
- **Text:** BrainPop video:

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**Review/Design Challenge Planning Day**

Based on what you’ve learned so far, use that knowledge to begin planning their design challenge. Students should focus on their understanding of erosion/deposition/Earth’s layers when planning.

**Assessment Day (optional)**

**Atmosphere (precip/clouds/temp/wind)**

TLWD an understanding of the atmosphere by discovering the various components.
| 14 | **Atmosphere (precipitation/clouds)** | Students will explore the elements of the atmosphere. Potential resources are linked above.  
Optional hands-on exploration:  
[Model of Earth’s Atmosphere](#)  
**OPTIONAL ASSESSMENT PIECES:**  
(covers atmosphere/ geosphere/ hydrosphere/ atmosphere). |
| 15 | **Hydrosphere** | Researching weather for their design challenge  
Students will use their knowledge of the atmosphere to begin researching the weather of where they plan to put their new land form. Students should focus on what potential hazardous weather may effect their land.  
**Mystery Science:** Can We Make It Rain? |
| 16 | **Hydrosphere as a system** | Research and graph the water in the hydrosphere ([activity through NJCTL](#)).  
**Mystery Science:** How Much Water Is In The World? |
| 17 | **Planning and/or Review Day** | Question: How do rivers/ streams/ oceans affect the ecosystems, landform shape, and climate?  
Students use their Chromebooks to self-investigate the response to the question above and create a written response. |
| 18 | **Assessment/Check for understanding** | Based on what you’ve learned so far, use that knowledge to continue planning their design challenge.  
Teachers can assess the unit to this point. Forms of assessment are up to the teacher.  
One possible option is to use this activity from [NJCTL on sphere interactions](#). |
| 19 | **Investigation** | **Text:** The River Ran Wild by Lynne Cherry  
Introduce [Land Plan Challenge](#) project and students create their piece of the town using the [map](#) and [map key](#).  
Overview of the project: Students will be creating their own map piece. Over the next days the pieces will be combined and students will see how the different parts of the town affect one another.  
Focus of Day 1: Where should the pieces of the town go based on the water in the town, etc.? |
<p>|  |  | <strong>Optional assessment pieces:</strong> |</p>
<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Investigation</td>
<td>TLWD an understanding of the impact of humans on the environment by investigating town layouts and the effect on the environment. Day 2: Students bring their pieces together and assemble a larger town. Focus: How do the communities combining effect the water, resources, etc.? Is the larger town well laid out?</td>
</tr>
<tr>
<td>21</td>
<td>Investigation</td>
<td>TLWD an understanding of the impact of humans on the environment by investigating town layouts and the effect on the environment. Students will reflect on their interactive town experience from the past two days. Students complete a written response to the question below: What impact does the layout of your town have on the town, environment, and atmosphere?</td>
</tr>
<tr>
<td>22</td>
<td>Design Challenge</td>
<td>(Approximately five days) TLWD the ability to summarize information and previous learning in order to create a new land form or island that can be self-sustaining. Students are given time to begin creating their new island/land form based on their understanding of the interactions of the spheres and human impact. Students should be creating a hands-on/visual representation. This can be built physically or digitally.</td>
</tr>
<tr>
<td>22</td>
<td>Present and Peer Review</td>
<td>Students present their design challenge. Peers ask questions and offer feedback. Optional: Pair with a class in another 5th grade class in Edison to share across the district.</td>
</tr>
<tr>
<td>23</td>
<td>Improve</td>
<td>(Approximately three days) Students are given time to revise their projects and finalize their plans based on the feedback of their peers.</td>
</tr>
</tbody>
</table>

### Additional Resources

- **Global Water Distribution**: In this lesson sequence, students predict and model the availability of water on Earth and discuss methods that can be used to purify and conserve this critical resource. They also assess how much water they and their families typically use, and think about ways to reduce their water usage. Finally, students explore different techniques being employed for water management around the world, including the use of dams to create reservoirs.

- **Simulating an Oil Spill to Understand Environmental Impact**: This 8 minute instructional video provides a model for teachers to follow of a week long investigation of oil spills and the environmental impact they have on shorelines and creatures. Students take on the task of cleaning up a simulated oil spill. Educator uses the 5E curriculum model to engage students with fiction and nonfiction texts before exploring methods that simulate an oil spill and its cleanup. Video demonstrates the key portions of the activity and models appropriate teacher questioning and interactions with the students.

- **NOAA What-a-Cycle**: Through role-playing as a particle of water, students gain an understanding of the complexity of the movement of water through earth’s systems. Stations are set-up for nine different water reservoirs associated with the water cycle. On each turn, students roll the dice at each station and either stay in place or move to a different location. Students track their unique journey through the water cycle to later share and discuss the strengths and limitations of the game as a model for the movement of water through Earth’s systems.
- **Shower Curtain Watershed**: What is a watershed? How do our actions affect the health of a watershed? Students explore these questions by analyzing pictures and identifying watershed features. Students then make a watershed model using a plastic shower curtain, a spray bottle of water and themselves or classroom objects. The objectives of the lesson are to: a) Identify nonliving and living features found in a watershed. b) Understand how human activities can affect watersheds.

- **Connect the Spheres: Earth Systems Interactions**: This activity was developed as an introductory experience to a series of lessons about water resources on Earth. Students will investigate Earth systems by making observations in nature and identifying systems in the natural world. Ultimately, the students will understand how the four spheres/systems on Earth (biosphere, hydrosphere, geosphere, and atmosphere) are interconnected.

- **Earth System Science**: These activities will help students learn about the Earth in a new way—as a living system. Students will learn to identify the parts of the Earth system and the processes that connect them.

- **Package Design**: Design Squad Pro File - Inspire students with this video of Jennifer Chua, a 25-year-old packaging engineer who works at Method, a company in San Francisco that specializes in non-toxic, biodegradable products. Jennifer makes high-quality products that are both good-looking and good for the environment.

- **Harmless Holder**: Design Squad Challenge - Discuss the negative effects of plastic six-pack holders on the environment. Challenge students to Invent a holder for six cans that's animal-safe, sturdy, convenient, and easy to carry.

- **StudyJams: Earth's Atmosphere**
- **StudyJams: Earth's Oceans**
- **Teach Engineering**: Browse for Additional Lessons, Activities, and Units
- **Crash Course Science**: YouTube Video Channel for Kids

### Teacher Professional Learning Resources

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

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

View the [resource collection.](#)

**Evaluating Resources for NGSS: The EQuIP Rubric**

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

View the [resource collection.](#)
NGSS Crosscutting Concepts: Systems and System Models

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

NGSS Core Ideas: 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.

NGSS Core Ideas: Earth and Human Activity

The presenters were Susan Buhr Sullivan, Director of the CIRES Education and Outreach Group at University of Colorado; and Aida Awad, Science Department Chair at Maine East High School in Park Ridge, IL and president of the National Association of Geoscience Teachers (NAGT). The program featured strategies for teaching about Earth science concepts that answer questions such as “How do humans depend on Earth’s resources?” and “How do humans change the planet?”

Dr. Buhr Sullivan began the presentation by describing the interconnections between this disciplinary core idea and other components of NGSS. She then talked about building a foundation for key concepts related to Earth and Human Activity at the elementary level. Ms. Awad continued the discussion by sharing the progression of this core idea through the middle school level and on to high school. The presenters provided a list of resources and activities that teachers can use to begin implementing NGSS in the classroom.

Visit the resource collection.

Assessment for the Next Generation Science Standards

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

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

View the resource collection.

NGSS Crosscutting Concepts: Patterns

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

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

**Bozeman Science**