Oklahoma Academic Standards for Science

Content Framework

Fifth Grade
OVERVIEW

The Oklahoma Academic Standards for Science describe the specific areas of student learning that are considered the most important for proficiency in the discipline at a particular grade level and provide a basis for the development of local curricula and statewide assessments. The Oklahoma Academic Standards were informed by A Framework for K-12 Science Education (National Research Council, 2012), Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993), The Next Generation Science Standards (2013), and the Oklahoma Priority Academic Students Skills for Science (Oklahoma State Department of Education, 2011).

LEARNING PROGRESSIONS

The Framework for K-12 Science Education (National Research Council, 2012), emphasizes the need for students to have repeated experiences, in every grade, with increasing sophistication across the grade levels. These opportunities allow students to continually build upon and revise their knowledge and abilities. “The goal is to guide their knowledge toward a more scientifically based and coherent view of the natural sciences and engineering, as well as of the ways in which they are pursued and their results can be used.” (NRC, A Framework for K-12 Science Education, 2012)

Three Dimensions of Science Instruction

The Oklahoma Academic Standards for Science are designed to address the rich and complex nature of science learning: the processes of thinking about, analyzing, and using science and engineering information, the fundamental concepts that are relevant to all subject areas, and the content that is unique to individual subject areas.

In the standards, three dimensions are referred to as:

1. Science and Engineering Practices: They represent the major practices that scientists and engineers use, practices that require both skill and knowledge.
2. Disciplinary Core Ideas: There are three major domains; Physical Science, Life Science, and Earth and Space Science.
3. Crosscutting Concepts: These connect ideas across all science disciplines. This is how Scientists and Engineers think.

When students have learning experiences that include each dimension in the context of the others, they are able to fully develop the skills and understandings associated with real science.
THREE DIMENSIONAL LEARNING

DIMENSION 1: SCIENCE AND ENGINEERING PRACTICES

Dimension 1 describes (1) the major practices that scientists employ as they investigate and build models and theories about the world, (2) a key set of engineering practices that engineers use as they design and build systems. Here, we use the term “practices” in place of “skills” to emphasize that engaging in scientific investigation requires both skill and knowledge that is specific to each practice. (NRC, A Framework for K-12 Science Education, 2012)

DIMENSION 2: DISCIPLINARY CORE IDEAS

The continuing expansion of scientific knowledge makes it impossible to teach all the ideas related to a given discipline in explicit detail during the K-12 years. We need to ensure we are preparing our students with sufficient core knowledge so that they can later continue to acquire additional information on their own. An education focused on a limited set of ideas and practices in science and engineering should enable students to evaluate and select reliable sources of scientific information, and allow them to continue their development well beyond their K-12 school years as science learners, users of scientific knowledge, and perhaps also as producers of such knowledge. (NRC, A Framework for K-12 Science Education, 2012)

DIMENSION 3: CROSSCUTTING CONCEPTS

Crosscutting concepts provide a connective structure that supports students’ understanding of science as disciplines and that facilitates students’ comprehension of the phenomena under study in particular disciplines. The crosscutting concepts also aid in students organizational framework for connecting knowledge from various disciplines into a coherent and scientifically-based view of the world. Explicit reference to the concepts, as well as their emergence in multiple disciplinary contexts, can help students develop a cumulative, coherent, and usable understanding of science and engineering. (NRC, A Framework for K-12 Science Education, 2012)
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Science and Engineering Practices

The Science and Engineering Practices describe the major practices that scientists employ as they investigate and build models and theories about the world and a key set of engineering practices that engineers use as they design and build systems. The term “practice” is used instead of the term “process” to emphasize that scientists and engineers use skill and knowledge simultaneously, not in isolation. The eight science and engineering practices are:

1. Ask questions and define problems
2. Develop and use models
3. Plan and conduct investigations
4. Analyze and interpret data
5. Use mathematical and computational thinking
6. Construct explanations and design solutions
7. Engage in scientific argument from evidence
8. Obtain, evaluate, and communicate information

Each Performance expectation integrates one of the above Science and Engineering Practices with a Disciplinary Core Idea in Science. The integration of Science and Engineering Practices with science content represents a shift from previous science standards in Oklahoma, giving the learning context and allowing students to utilize scientific reasoning and critical thinking to develop their understanding of science.

Taken from the Oklahoma State Department of Education Science Standard document
The Engineering Design Process is a simple process that is easy for students to use and understand. This process can be started at any point, move back and forth between steps, or repeat the cycle. Students are engaged in different activities at each point. Here is an overview of each step:

**ASK:** What is the problem?

**RESEARCH:** How have others approached it? What are your constraints?

**IMAGINE:** What are some solutions? Brainstorm ideas. Choose the best one.

**PLAN:** Draw a diagram. Make lists of materials you will need.

**CREATE:** Follow your plan and create something.

**TEST:** Test it out! Try out the design solution and see if it works.

**IMPROVE:** What works? What doesn't? What could work better? Modify your design to make it better. Test it out!

Source:
The 5E Model is an instructional model based on the constructivist model, which states that learners construct or build new ideas off of those they previously had. Each of the 5Es describes a phase of learning and can be used with any age student, including adults. The BSCS 5E Instructional Model lets you think about an integrated instructional unit. The lesson is your basic unit of instruction, but with the new Oklahoma Academic Standards for Science, the 5E Model allows you to translate your lessons into classroom instruction with a sequence of integrated instructional activities.

**Figure 4.1. Purposes of the Phases in the BSCS 5E Instructional Model**

<table>
<thead>
<tr>
<th>ENGAGE</th>
<th>EXPLORE</th>
<th>EXPLAIN</th>
<th>ELABORATE</th>
<th>EVALUATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Create interest and stimulate curiosity.</td>
<td>- Provide experience of the phenomenon.</td>
<td>- Introduce concepts and practices that can be used to interpret data and construct explanations.</td>
<td>- Use and apply concepts and explanations in new contexts.</td>
<td>- Provide an opportunity for students to review and reflect on their understanding and skills.</td>
</tr>
<tr>
<td>- Provide a meaningful context for learning.</td>
<td>- Examine students’ questions to test their ideas.</td>
<td>- Construct multimodal explanations and justify claims in terms based on evidence.</td>
<td>- Reconstruct and extend explanations using different modes, such as written language, diagrammatic and graphic modes, and mathematics.</td>
<td>- Provide evidence for changes to students’ understanding, beliefs, and skills.</td>
</tr>
<tr>
<td>- Raise questions for inquiry and science practices.</td>
<td>- Investigate questions and problems.</td>
<td>- Compare different explanations generated by students.</td>
<td>- Review current scientific explanations.</td>
<td>- Provide an opportunity for students to review and reflect on their understanding and skills.</td>
</tr>
<tr>
<td>- Reveal students’ current ideas and beliefs.</td>
<td></td>
<td>- Review current scientific explanations.</td>
<td></td>
<td>- Provide evidence for changes to students’ understanding, beliefs, and skills.</td>
</tr>
</tbody>
</table>

*Source: Adapted from AAS 2008.*

*Source: Bybee, Rodger W., author. The BSCS 5E Instructional Model: Creating Teachable Moments. Arlington, Virginia :NSTA*
Making Cross-Curricular Connections

Speaking and Listening
*Links to new ELA Standards coming soon

Math
*Links to new Math Standards coming soon

Literacy Connections

Unit 1 (Interaction of Matter) Temperature: Heating Up and Cooling Down By Darlene Stille

Unit 2 (Reactions and Properties of Matter) Freezing and Melting By Robin Nelson, Solids, Liquids, and Gases: My World Science By Angela Royston, Solid, Liquid, Gas? By Sally Hewitt,


Unit 5 (Sun, Moon, Stars, and Earth) Earth: Our Planet in Space by Seymour Simon, Me and My Place in Space by Joan Sweeney, The Moon Seems to Change by Franklyn Branley, Planet Earth, Inside and Out by Gail Gibbons, Postcards From Pluto: A Tour of the Solar System by Loreen Leedy

Unit 6 (Human Interaction on Ecosystems and Earth) Natural and Man-Made: My World Science By Angela Royston, The Gift of the Tree By Alvin Tresselt, A Handful of Dirt By Raymond Bial, Oil Spill! By Melvin Berger, Shelterwood By Susan Hand Shetterly, What Planet Are You From, Clarice Bean? By Lauren Child

Unit 7 (Robotics and Automation) If I Built a Car by Chris Van Dusen, Imaginative Inventions by Charise Mericle Harper

Unit 8 (Robotics and Automation Challenge)
Domain Comparison Chart

The Oklahoma Academic Standards (OAS) for Science are divided into 3 Domains. These are Physical Science, Earth and Space Science, and Life Science. These Domains are then further divided into 11 Disciplinary Core Ideas (DCI) which progress throughout all grade levels. The chart below explains the vertical alignment of the Domains and DCIs for Kindergarten through Fifth Grade.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Earth And Space</th>
<th>Physical Science</th>
<th>Life Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCI</td>
<td>ESS1 ESS2 ESS3</td>
<td>PS1 PS2 PS3 PS4</td>
<td>LS1 LS2 LS3 LS4</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>K K K</td>
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<tr>
<td>First Grade</td>
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<td>Second Grade</td>
<td>2 2 2</td>
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<td>1 1 2 2</td>
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<td>Third Grade</td>
<td>3 3 3</td>
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<td>3 3 3 3 3</td>
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<tr>
<td>Fourth Grade</td>
<td>4 4 4</td>
<td>4 4 4</td>
<td>4 3 3 3 3</td>
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<tr>
<td>Fifth Grade</td>
<td>5 5 5</td>
<td>5 5 5</td>
<td>5 5 5 5 5</td>
</tr>
</tbody>
</table>
# Fifth Grade Unit Scope and Sequence

<table>
<thead>
<tr>
<th>Month</th>
<th>District Unit</th>
<th>Domain</th>
<th>Disciplinary Core Idea</th>
<th>Focus Standard(s)</th>
<th>Unit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>1</td>
<td>Physical Science</td>
<td>Interaction of Matter</td>
<td>5-PS1-1 5-PS1-2</td>
<td>Students have an opportunity to understand that everything is made up of matter and that matter is made of particles that are too small to be seen. Students should be given opportunities to gather and analyze data to determine that matter exists at a scale that is too small to be seen. Students will develop and communicate their understanding of this abstract concept by observing instances where they know matter is taking up space even if they can’t see the things that make up matter. For example, inflating a balloon or basketball. Students will collect data to make claims that air is made of particles too small to see and create a diagram model of their understanding.</td>
</tr>
<tr>
<td>October</td>
<td>2</td>
<td>Physical Science</td>
<td>Reactions and Properties of Matter</td>
<td>5-PS1-3 5-PS1-4</td>
<td>This unit focuses on the properties of materials and interactions among substances that result in new substances forming. In this unit, students focus on the crosscutting concept of cause and effect in addition to scale, proportion and quantity in relation to properties of materials and interactions among substances. Students will conduct investigations to make observations of materials such as foam insulation, plastic, copper, steel, and wood to identify materials that conduct electricity and/or heat. Then, students should plan and carry out substance mixing investigations to gain observational data that can be used to make claims about whether a new substance is formed. A complete understanding of physical and chemical changes and the differences between them is not intended at this grade.</td>
</tr>
<tr>
<td>November</td>
<td>3</td>
<td>Life Science</td>
<td>Flow of Matter and Energy</td>
<td>5-LS1-1 5-LS2-1 5-PS3-1</td>
<td>Students will develop and use models to gain an understanding on how ecosystems and their various components interact with each other. Students should be able to construct an argument to explain that the food of almost all animals can be traced back</td>
</tr>
</tbody>
</table>
through the web of relationships in the ecosystem to plants and as a result of the sun. Students can develop models to show the connections between organisms in the food web and how energy and matter flow between these organisms.

<p>| December | 4 | Earth and Space Science | Water Systems and Earth Materials | 5-ESS2-1 5-ESS2-2 | Students will examine the components in each Earth system and how those components interact with one another. Students will develop models to examine how each Earth system interact with other Earth systems. Students should also develop a model to explain the phenomena that result from interaction between landforms and the atmosphere. Students will make observations and collect data about the parts of each of the Earth systems. Students will then obtain and evaluate information to construct arguments based on their observation for why it is important to preserve the water we currently have available for human use. |
| January | 5 | Earth and Space Science | Sun, Moon, Stars, and Earth | 5-ESS1-1 5-ESS1-2 5-ESS2-1 | Students will collect observational data by observing the stars in the night sky. Since understanding the scale of the universe can be difficult for students, they can also be given the opportunity to collect observational data through models that represent the distance from stars to Earth. Students will analyze and interpret data collected from observations of the motion of the stars and moon to determine patterns in their position and motion. Then, students will analyze and interpret data in order to understand the regular patterns of the motion of the stars, planets, and moons. |
| February | 6 | Life Science Earth and Space Science | Human Interaction on Ecosystems and Earth | 5-LS2-2 5-ESS3-1 | Students should have the opportunity to evaluate what makes an ecosystem healthy and factors that may or may not upset the health of an ecosystem. In determining the health of ecosystems or factors that may impact an ecosystem, students will collect data from observations or text in order to develop models of ecosystems and their counter parts. When developing ecosystem models, students should consider all of the |</p>
<table>
<thead>
<tr>
<th>Month</th>
<th>Week</th>
<th>Module Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>7</td>
<td>Robotics and Automation PLTW Module</td>
<td>Student’s exploration of robotics includes ways that robots are used in today’s world and the impact of their use on society and the environment. Students learn about a variety of robotic components as they build and test mobile robots that may be controlled remotely. The design problem provides an opportunity for students to apply their robotic skills and knowledge to solve a real-world problem related to environmental disaster cleanup.</td>
</tr>
<tr>
<td>April</td>
<td>8</td>
<td>Robotics and Automation Challenge PLTW Module</td>
<td>Students expand their understanding of robotics as they explore mechanical design and computer programming. The focus for this module centers on developing skills needed to build and program autonomous robots. Students develop programming skills in a variety of platforms, including tablet applications and browser-based programming environments. Finally, students apply the robotics knowledge and skills they have developed to build and program an autonomous robot to solve a real-world design problem.</td>
</tr>
</tbody>
</table>
The Oklahoma State Department of Education is excited to announce the release of the first resources being offered through the Oklahoma Academic Standards Science Frameworks. The Science Frameworks represent curricular resources developed by Oklahoma teachers to help teachers translate standards into classroom practice. The Framework Overviews represent how a group of Oklahoma teachers, at a given grade level, might bundle performance expectations/standards found in the Oklahoma Academic Standards for Science. Bundling is how teachers would group performance expectations/standards for the purpose of developing instructional units of study.

Once bundled, the Science Framework writers were then charged with completing four categories of information that coincided with the bundle of performance expectations/standards. The categories provide insight into how the Science Framework writers collaborated to begin to translate standards into classroom instruction. The guidance provided in the categories does not represent a directive to teachers, schools or districts for classroom instruction and should not be viewed as such.

The Oklahoma State Department of Education would like to say a special thank you to the Oklahoma educators who participated in developing the Oklahoma Science Framework Overviews and to Quentin Biddy, the project director.

### Science Framework Writers

<table>
<thead>
<tr>
<th>Solomon Bayouth</th>
<th>Megan Cannon</th>
<th>Wendy Howard</th>
<th>Jenny Thompson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elizabeth Beck</td>
<td>Mandi Cloud</td>
<td>Traci Richardson</td>
<td>Sarah Vann</td>
</tr>
<tr>
<td>Colleen Bennett</td>
<td>Benjamin Cottingham</td>
<td>Georgia Smith</td>
<td>Megan Veldhuizen</td>
</tr>
<tr>
<td>Rachel Brown</td>
<td>Jennifer Crabb</td>
<td>Stacey Stapelton</td>
<td>Tammy Will</td>
</tr>
<tr>
<td>Randi Butcher</td>
<td>Maria Harris</td>
<td>Amy Tankersley</td>
<td>Susan Wray</td>
</tr>
</tbody>
</table>

“The vision of the Overviews is to provide a resource for teachers that encourages them to embrace the new standards and implement them effectively in their classrooms. The suggestions provided by the frameworks project do not have to be implemented exactly as they are written and are not required to be a successful teacher, but serve as a guide to setting up effective lessons that will help students meet the necessary levels of success in a science classroom.” - Oklahoma Science Framework Project Writer

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How To Read This Document

Below you will find short descriptions about each of the sections of information provided in this document. If you have questions regarding the Framework Overviews, please contact Tiffany Neill at 405-522-3524 or Tiffany.Neill@sde.ok.gov

Science Framework Overview: Sections

In Lay Terms

This section aims at providing a brief introduction to the goals outlined in the Performance Expectation Bundles/grouping of standards.

Three Dimensional Storyline

This section aims at providing a comprehensive instructional storyline of how the three dimensions represented in the Performance Expectation Bundles intertwine to support students engaging in science and engineering practices, crosscutting concepts and disciplinary core ideas. Keep in mind each performance expectation includes one science and engineering practice, one crosscutting concept and one disciplinary core idea. The color-coding in this section allows teachers to see where components of these three dimensions appear in the instructional storyline. To find out more about the three dimensions and how they are incorporated into the Oklahoma Academic Standards for Science, review pages 7-8 in the Oklahoma Academic Standards for Science or check out the OKSci PD on Your Plan Module series, Transitioning to the Oklahoma Academic Standards for Science.

Lesson Level Performance Expectations

This section aims at providing scaffolding three-dimensional learning targets that teachers can design instruction around to meet the end goals of the Performance Expectation(s) represented in the bundles or units of study. Keep in mind the performance expectations represent the things students should know, understand and be able to do to show proficiency at the end of instruction they participate in. A teacher can utilize the Lesson Level Performance Expectations in each bundle as a way to develop a series of instruction to meet the end goals of the performance expectations. For example, a teacher can develop or use a lesson, which may allow students to participate in instruction that covers some of the Lesson Level Performance Expectations, but not all. In this case the teacher would then develop or conduct another lesson that covers other Lesson Level Performance Expectations in the bundle.

Misconceptions

This section aims at providing research-based misconceptions that students frequently have related to the science concepts (disciplinary core ideas) embedded in the Performance Expectation Bundles along with matching correct conceptions.

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2 Download the Oklahoma Academic Standards for Science at http://sde.ok.gov/sde/science.
3 Access the OKSci PD on Your Plan Modules at: https://www.evernote.com/l/AUXXIQC1zVZDeLmUkOMPpjhKeJjqS-R8qww
Bundle: Interaction of Matter

5-PS1-1 *Students who demonstrate understanding can:*

**Develop a model to describe** that matter is made of particles too small to be seen.

5-PS1-2 *Students who demonstrate understanding can:*

**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.

**In Lay Terms**

Everything around us (matter) is made up of particles that are too small to be seen. Although students cannot see the actual particles that make up matter, they can use models to gain an understanding of these tiny particles. Matter can change in different ways. When a substance, like water, undergoes a physical change such as freezing, melting, or evaporating, it will have the same amount of matter after the physical change as it did before the physical change. Similarly, even if a change results in a new substance the total weight of the new substance(s) will be the same as the total weight of the beginning substances. Regardless of the type of change, none of the tiny particles that make up matter is lost, the total weight of the system is the same.

**Three Dimensional Storyline**

In this bundle of performance expectations students have an opportunity to understand that *everything is made up of matter* and that matter is made of particles that are too small to be seen. Students should be given opportunities to *gather and analyze data to determine* that matter exists at a *scale* that is too small to be seen. Students can *develop and communicate their understanding* of this abstract concept by observing instances where they know matter is taking up space even if they can’t see the things that make up matter. For example, *by inflating a balloon or a basketball, students can see air moving into the system causing it to expand*, even though they cannot see the air. Students can *gather additional data to make claims* that *air is made of particles too small to see*. *Measuring the weight* of the balloon or basketball before and after inflating it, can help students better understand this concept. Students can *create a diagram model* of their understanding of the matter (air) going *into* the balloon or basketball, including small dots *inside* and *outside* of the balloon or basketball to represent the air particles that are present in the *system*. Keep in mind, at this age students can begin to examine the world around them and think about everything as a *system* or an organized group of related objects or components that form a whole.

Students at this level should have some experiences with *measuring* length and in this bundle students will expand on *measurement to include* weight and where appropriate, *volume*: this will guide them in their understanding that *matter is made of particles too small to be seen*. For example, students can compress air in a sealed syringe to show that even though the *volume inside the syringe changes*, no air
particles leave the system and the mass remains the same. Alternately if a syringe is unsealed, as the volume inside the syringe increases, more air particles are pulled into the syringe. Students should be able to construct a model, such as diagrams, pictures, or simulations to communicate their understanding of this concept.

In this particular bundle, students can model that matter is made up of particles that cannot be seen, such as drawing a diagram to show how sugar dissolves in water or how water, freezes, melts, evaporates, or condenses. A student-developed model will vary in quality based on how deep an understanding they have of the system they are modeling, their skill level, and their prior knowledge. As these improve, their models will also improve.

Students can use their understanding of particles of matter to consider what happens to the number of particles when matter changes in form (from liquid to solid, solid to liquid, liquid to gas) or when substances are mixed. Students can conduct investigations about this and collect measurable data about the weight of a substance before and after it changes forms or reacts with another substance. For example, when water changes state from a solid to a liquid or when baking soda and vinegar react the total weight of the substance(s) is the same before and after the changes take place. Students should be given an opportunity to investigate this concept with a variety of substances so that they can detect the pattern that matter is conserved.

Lesson level Performance Expectations

- Students can analyze and interpret data to determine that matter can be subdivided into smaller particles that can be detected by other means.
- Students can develop a model to show that matter exists in particles too small to be seen.
- Students can use a model to explain that gases are made of particles too small to see and are moving freely.
- Students can conduct investigations to determine that matter still exists and can be detected through means other than sight.
- Students can construct an argument using evidence that air particles, which are too small to be seen, can affect larger particles and objects.
- Students can plan and conduct an investigation to gather evidence to demonstrate that the amount of matter is conserved when it changes form.
- Students can analyze and interpret data collected from investigations to determine that even when matter seems to vanish during a change it is still conserved.
- Students can use mathematical and computational thinking during an investigation to demonstrate that during a chemical reaction, the weight of a substance does not change.

<table>
<thead>
<tr>
<th>Misconceptions</th>
<th>Accurate Concept</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
1. When matter disappears, it no longer exists.
2. Gas makes things lighter. Air has no weight, color or odor and is in effect invisible and inconsequential.

1. Matter can be changed from one form to another, but not destroyed.
2. Gas (air) has mass, takes up space, and is affected by energy.

References

- [http://www.rsc.org/images/Misconceptions_update_tcm18-188603.pdf](http://www.rsc.org/images/Misconceptions_update_tcm18-188603.pdf)
5-PS1-3 Students who demonstrate understanding can:

**Make observations and measurements** to identify materials based on their properties.

5-PS1-4 Students who demonstrate understanding can:

**Conduct an investigation to determine** whether the mixing of two or more substances results in new substances.

### In Lay Terms

Everything around us has unique properties that can be used to identify them, such as what color they are, how hard they are, if they reflect light, whether they conduct electricity or heat, whether they are magnetic, and whether they dissolve in water. All of the properties can be observed and measured. Students can use these properties to determine identities of substances. Additionally, each type of material or substance has unique properties can be used to predict what kind of changes could occur when the material or substance interacts with other materials or substances.

### Three Dimensional Storyline

This bundle of performance expectations focuses on the properties of materials and interactions among substances that result in new substances forming. In this bundle, students focus on the crosscutting concept of **cause and effect** in addition to **scale, proportion and quantity** in relation to properties of materials and interactions among substances.

All matter has observable properties that can be measured, tested, identified, and used to identify materials. Students can **carry out investigations to collect** both measurable numeric data (quantitative) such as weight and temperature and non-measurable numeric data (qualitative) such as color, smell, hardness, reflectivity, electrical and thermal conductivity, response to magnetic fields, and solubility to group and identify materials and substances. For example, hardness, reflectivity, and color can be used to identify and classify rocks and minerals. Students can **conduct investigations to make observations** of materials such as foam insulation, plastic, copper, steel and wood to identify materials that **conduct electricity and/or heat**.

Matter can undergo both physical and chemical changes. Physical changes occur when a substance’s physical properties change, but not its chemical properties. For example, when water freezes to form ice (solid), ice melts to form water (liquid), or water evaporates to form a gas it undergoes a physical change but not a chemical change. In each case the water is made up of molecules that consist of two hydrogens and one oxygen. It is simply changing in states and therefore some of its physical properties are changing. **When certain substances are mixed**
with other substances a change can occur that results in a new substance. This is called a chemical change. There are other ways that chemical change can occur, like when a substance is burned. However at this age, students are not expected to know physical and chemical change. They are only asked to explore the mixing of two substances to determine if a new substance is formed. This lays the groundwork for students to explore the differences between physical and chemical changes in later grades.

When a new substance is formed, common observable properties occur, such as color change (e.g. rust is the result of iron reacting with oxygen), temperature change (e.g. the chemical change itself either releases energy as heat or takes in energy and becomes cold), formation of a gas or a precipitate (a solid that forms from two liquids reacting) forming. In a physical change, these property changes are due to external factors whereas in a chemical changes the interaction of the substances themselves cause these property changes. Since these property changes are also observable in physical changes (state of matter transformation). The focus at this age should be on students planning and carrying out substance mixing investigations to gain observational data that can be used to make claims about whether a new substance is formed. A complete understanding of physical and chemical changes and the differences between them is not intended at this grade. For example, students can analyze the changes that occur when salt or sugar is added to water. While the salt or sugar dissolves in water, it can be separated back out by evaporating the water. This would allow students to see that the substances didn’t really change because the two substances can be separated back out. However if students mix fruit juice or vinegar with baking soda they will see a gas is given off immediately. This is an indicator that a new substance has formed. Through multiple investigations, students can analyze a variety of data that would help them make a claim that a new substance forms when it cannot go back to its original form. A variety of methods can be used to communicate the information they have gained through these investigations about properties and changes in substances: before and after pictures, data chart, flow charts, etc.

**Lesson Level Performance Expectations**

- Students can conduct an investigation to measure and observe the properties (color, hardness, reflectivity, electrical conductivity, response to magnetic fields, and solubility) of matter such as powders, metals, minerals, and liquids.
- Students can plan and carry out an investigation to determine if mixing two different substances react to form a new substance.
- Students can analyze observational data to determine that mixing substances, like baking soda and vinegar, can result in a new substance with properties different from the initial substances.

<table>
<thead>
<tr>
<th>Misconceptions</th>
<th>Accurate Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A chemical reaction always happens when two substances are combined together.</td>
<td>1. Not all substances react when combined.</td>
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</tbody>
</table>
**Bundle: Flow of Matter and Energy**

5-LS1-1 *Students who demonstrate understanding can:*

Support an argument that plants get the materials they need for growth chiefly from air and water.

5-LS2-1 *Students who demonstrate understanding can:*

Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-PS3-1 *Students who demonstrate understanding can:*

Use models to describe that energy in animal’s food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

**In Lay Terms**

Students should be able to understand that each component of an ecosystem is connected to the other components in the ecosystem and relies on the other components to survive. Food and other materials are broken down and cycled between the air, plants, animals, and the soil. All of the energy that drives these systems comes from the sun. Students should understand that in order for a plant to survive, it must receive its nutrients and material needed for growth from the air and water.

**Three Dimensional Storyline**

Energy and matter flow through ecosystems between the air, soil, plants, animals, and microbes. Energy and matter are utilized by organisms existing within these ecosystems. All energy that flows through and enters most ecosystems begins with the sun. Students can develop and use models to gain an understanding of how ecosystems and their various components interact with each other. Within each unique ecosystem energy and matter move throughout each part of the system and is transferred between components within the system in different ways.
Plants are the base of most ecosystems. Plants capture energy from the sun and utilize it along with material from air, soil, and water in a chemical process to create new plant matter. Students should be able to construct an argument to explain that the food of almost all animals can be traced back through the web of relationships in the ecosystem to plants and as a result the sun. In ecosystems, all of the organisms are related to each other in what can be modeled as a food web. Students can develop models to show the connections between organisms in the food web and how energy and matter flow between these organisms. For example, some animals, herbivores, eat plants (which take energy into the system from the sun) for food. Other animals, carnivores, eat the animals that eat the plants. Other organisms, decomposers, break down dead plants and animals, recycling nutrients and material back into the soil to be used by plants again. Students can develop models to explain their understanding of the role of each of these types of organisms within the ecosystems.

An ecosystem’s health can be measured by the number of different species that survive in an ecosystem (biodiversity) and an organism can only survive in environments where their particular needs are met. Students should have opportunities to collect and analyze data to make inferences about the health of those ecosystems. When the biodiversity is low in an ecosystem, meaning that there are relatively few different species in the ecosystem the system can easily become unstable if any component of the ecosystem changes. When there is low biodiversity in an ecosystem, changing conditions can have greater impacts on the entire system by increasing or decreasing of a species, impacting the entire food web, or the introduction of a new species. An example of this can occur in lakes and reservoirs when invasive non-native species such as Asian carp and Daphnia lumholtzi, an African water flea, are introduced from outside sources like boats. Once introduced to these systems these invasive species replace native species and either outcompete or create toxic environments in which the native species can no longer survive. This in turn affects other organisms within the food web in the system. This may lead to an increase or decrease in the number of species in a population. Students can plan and conduct investigations and use mathematical thinking to determine the stability of an ecosystem (e.g. predator/prey relationships). Introducing new species to an ecosystem can disrupt the stability of the system.

In this bundle of performance expectations, students should gain an understanding of systems and system models as well as develop and use models (including diagrams, flow charts, etc.) to show their understanding of the different parts of an ecosystem. Students should understand that a system as a whole can carry out functions that the individual parts cannot. The crosscutting concept of systems and system models will aid students in their discovery by providing them with a visual model of how organisms and energy interact with each other within an ecosystem. Students must understand that within the system energy and matter move throughout each part of the system and are transferred between components in different ways.

**Lesson Level Performance Expectations**

- Students can **construct an argument using evidence** that almost any kind of animal's food can be traced back to plants.
- Students can **develop a model** that demonstrates the relationships between organisms in food webs in which some animals eat plants for food and other animals eat the animals that eat plants.
- Students can construct an explanation about how decomposers function in an ecosystem by breaking down dead plants and animals.
- Students can use a model to explain how decomposition recycles some materials back to the soil in an ecosystem.
- Students can ask questions to investigate how organisms can only survive in environments in which their particular needs are met.
- Students can plan and carry out investigations in order to determine how a healthy ecosystem operates.
- Students can use mathematical thinking to gain an understanding that an ecosystem's health is related to the number of multiple species in a stable ecosystem able to meet their needs within the ecosystem.
- Students can develop and use a model to explain that when a new species is introduced, it can damage the balance of an ecosystem.
- Students can use a model to demonstrate that matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die.
- Students can analyze and interpret data to understand how organisms obtains gases, and water, from the environment, and release waste matter back into the environment.
- Students can construct and support an argument that demonstrates that energy released from food was once energy from the sun.
- Students can develop a model to demonstrate that plants acquire their material for growth primarily from air and water.
- Students can evaluate information and communicate that food provides animals with the materials they need for body repair and growth.
- Students can make a claim and support it with evidence that food provides animals with the energy they need for body warmth and motion.

<table>
<thead>
<tr>
<th>Misconceptions</th>
<th>Accurate Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All animals in an ecosystem get along with each other.</td>
<td>1. Within an ecosystem, species compete for resources and feed on one another.</td>
</tr>
<tr>
<td>2. Plants are dependent on humans.</td>
<td>2. While people often care for plants (especially those indoors), plants as a whole are not dependent on people for their needs.</td>
</tr>
<tr>
<td>3. Plants cannot defend themselves.</td>
<td>3. Plants have a range of defenses including external structures (sap, hairs, thorns, wax) and chemicals that either reduce digestibility or are toxic.</td>
</tr>
<tr>
<td>4. Organisms higher in a food web eat everything that is lower in the food web.</td>
<td>4. Organisms higher in a food chain eat some, but not necessarily all, of the organisms below them in the food web.</td>
</tr>
<tr>
<td>5. Decomposers release some energy that is cycled back to plants.</td>
<td>5. Decomposers break down dead organisms, returning nutrients to the soil so they can be used by plants. Some decomposers are eaten by carnivores.</td>
</tr>
<tr>
<td>6. Plants get their energy from the soil through roots.</td>
<td>6. Plants take in air through their leaves. Chloroplasts in the plant absorb the sun's energy for use in photosynthesis. Water and minerals are taken in through the roots.</td>
</tr>
</tbody>
</table>
References


**Bundle:** Water Systems and Earth Materials

5-ESS2-1 Students who demonstrate understanding can:
*Develop a model to describe* ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5-ESS2-2 Students who demonstrate understanding can:
*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.

**In Lay Terms**

All of Earth’s features, everything on land (soil, sediments, rocks, and landforms), all the water, and all living things on Earth interact with each other. For example, Earth’s vast oceans support life, Earth’s atmosphere is influenced by the surface features of the Earth creating weather and Earth’s surface is weathered and eroded by wind and water. Most of Earth’s water is unusable and found in oceans, while a small amount of freshwater is accessible to humans. In this bundle, students can explore Earth’s major systems and see how these systems interact with each other.

**Three Dimensional Storyline**

*Earth is a complex system that consists of four major subsystems:* the geosphere, hydrosphere, atmosphere, and biosphere. In this bundle of performance expectations, students can *examine the components* in each Earth system and how those components interact with one another. Students can *develop models to examine* how each Earth system interacts with other Earth systems. The geosphere, for example, consists of soil, solid rock, molten rock, and sediment (sand, silt, and clay), which make up the continents and the ocean floor. The soil *holds and transfers energy in the form of heat* into the atmosphere (air). The soil also supports the biosphere (living things) by providing shelter for animals and insects and providing a rich environment for plant roots to reside.

The hydrosphere consists of the oceans, ponds, lakes, streams, and all ice on Earth. Water *continuously moves through and interacts with* the geosphere, atmosphere, and biosphere via the water cycle. The Earth’s landforms interact with the wind and clouds in the atmosphere.
causing weather patterns to occur. For example, when warm, moist air is pushed up a mountain range, it cools and changes state (condenses) resulting in precipitation. When the air moves back down the other side of the mountain range, the air become dry and hot influencing the climate associated with these locations. Students can develop a model to explain the phenomena that result from interaction between landforms and the atmosphere.

Precipitation shapes Earth’s surface through weathering and erosion molding the landforms found on Earth. Water, ice, wind, living organisms and gravity break rocks, soils and sediments into smaller particles and moves them around. Students can conduct nature walks in order to make observations and collect data about the parts of each of the Earth systems. Once the parts of the systems have been identified, students can begin to consider their interactions and make models to explain these interactions and their effects on the systems and the systems’ components.

Earth’s biosphere consists of plants and animals, including humans. The biosphere is dependent upon the other major earth systems and the resulting interactions between them for survival. For example, growing plants release oxygen into the atmosphere, which animals take in and animals release carbon dioxide into the atmosphere, which is taken in by plants. Evaporation of water from Earth into the atmosphere causes rain to fall back to Earth in other areas, which provides water to growing plants and animals and shapes Earth’s surface by flowing downhill into streams and rivers, carrying with it soil particles (sediment), most of which ends up in the oceans.

Once students have had an opportunity to examine Earth’s systems and their interactions they can take a closer look at the distribution of water on Earth to further consider its impact on other Earth systems. Students can obtain and evaluate information to determine that even though oceans hold most of the water on Earth, it is saltwater, and not fresh and most of the freshwater on Earth is found underground and in glaciers while, a very small percent is found in rivers, lakes, streams, and the atmosphere. Students can use mathematical thinking to construct graphs to model the percentage of freshwater on earth that is available compared to the distribution of saltwater sources around the world. Students can use water distribution data to address questions about water usage and water preservation measures. Using this data, students can make claims that although water can be recycled, it is finite and not a renewable resource. Students can also construct arguments for why it is important to preserve the water we currently have available for human use.

In identifying the distribution of freshwater and saltwater on Earth, students can consider the vast amounts of saltwater found on Earth in oceans and how the oceans support a unique and vast number of living organisms. For example, there are many groups of living organisms in the oceans that do not appear anywhere else on earth (squid, octopus, jellyfish, and seaweed). Oceans support unique ecosystems like, coral reefs that provide shelter and food for many ocean organisms. Students can then again consider how the hydrosphere (in the form of saltwater in the ocean) interacts with the other Earth systems.
Lesson Level Performance Expectations

- Students can gather information about how the hydrosphere (water), atmosphere (air), geosphere (soil), and biosphere (life) interact as components within a closed system.
- Students can develop a model to explain how the interactions between the hydrosphere (water), atmosphere (air), geosphere (soil), and biosphere (life) impact Earth's surface materials and processes.
- Students can obtain information from a variety of sources to determine how the ocean supports a variety of ecosystems and organisms.
- Students can develop a model to explain how the ocean shapes landforms, and influences climate.
- Students can analyze and interpret data to understand that wind and clouds in the atmosphere interact with landforms to determine weather patterns.
- Students can use mathematical thinking to graph quantities such as area and volume to prove that nearly all of Earth's available water is contained in Earth's oceans.
- Students can analyze and interpret data to show that most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- Students can construct an argument using evidence to explain that although fresh water is renewable, it is a finite source and should be preserved.

Misconceptions

1. The atmosphere, hydrosphere, lithosphere, and biosphere do not cause changes in one another; these systems operate independently on Earth.
2. Events that occur on a continent do not affect oceans or the atmosphere.
3. There is no real connection between groundwater and surface water systems.
4. Icebergs are made of saltwater.

Accurate Concept

1. The atmosphere, hydrosphere, lithosphere, and biosphere are all interacting systems.
2. Events occurring on the continents can affect the oceans and the atmosphere and events occurring in the oceans or atmosphere can affect the continents.
3. Groundwater systems and surface water systems interact over long time spans.
4. Icebergs are composed of freshwater.

References
Bundle: Sun, Moon, Stars and Earth

5-ESS1-1 Students who demonstrate understanding can:
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-ESS1-2 Students who demonstrate understanding can:
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-PS2-1 Students who demonstrate understanding can:
Support an argument that the gravitational force exerted by the Earth is directed down.

In Lay Terms

The sun is the closest star to earth and is the center of our solar system. The sun appears as the brightest object in the sky because of its proximity to Earth. Other stars may be much brighter or larger, but are much farther from Earth so that they appear dimmer and smaller. Gravitational force from the sun and the planets keep the planets in orbit around the sun, and moons in orbit around planets. This gravitational pull always pulls down to the center of the celestial object (sun, moon, or planets). As these objects move around the sun, changes such as the movement of shadows, night and day, nightly, monthly, and seasonal movements of the stars and moon can be observed.

Three Dimensional Storyline

The sun is a star, the brightest and largest object in our sky. However, its size and brightness are due to its closeness to Earth. Many stars in the sky that are much dimmer or smaller only appear that way because of their distance from Earth.

Students can collect observational data by observing the stars in the night sky. Since understanding the scale of the universe can be difficult for students at this age, they can also be given the opportunity to collect observational data through models that represent the
distance from stars to earth. Students can analyze and interpret data collected from observations of the motion of the stars and the moon to determine patterns in their position and motion. For example students can make observations about the phases of the moon and lunar or solar eclipses and develop models to explain the patterns they observe.

All of the objects in the universe exhibit gravity to some degree. Gravity holds Earth in orbit around the sun, and it holds the moon in orbit around Earth. As in other planetary objects, Earth’s gravitational force pulls objects down toward its center. It is this constant force that keeps objects in the universe in place. Both Earth and our Moon exhibit gravity, but because Earth is larger, its force of gravity is greater. Students can engage in investigations of falling objects of various sizes, graph and compare the evidence to support that gravity pulls all objects down.

The students can analyze and interpret data in order to understand the regular patterns of motion of the stars, planets, and moons. For example, the moon’s regular, cyclical orbit around the Earth and the position of the Earth and moon relative to the sun can be analyzed using models to construct an explanation for the moon’s phases. Likewise, the position of the sun, Earth, and moon in relation to each other at different times within their normal paths of motion can be used to explain and predict lunar and solar eclipses. Other patterns are predictable as well, such as day and night, which are caused by the rotation of Earth on its axis between its North and South Poles, and the changing seasons which are a result of the tilt of Earth on its axis and Earth’s revolution around the sun. As the seasons change, so do the patterns of stars in the nighttime sky.

Among all the stars in the sky, the sun appears brightest. Students can analyze and interpret data about the distance from the Earth, size, brightness, and temperature of a range of stars to gain an understanding that the sun is an average star, meaning that there are larger and brighter stars and smaller and dimmer stars than the sun. Through analysis of data and pattern recognition, students can construct an argument from evidence that the sun only appears to be the brightest in our sky because of the proximity of the sun to the Earth. By gaining an understanding of the recognizable and predictable patterns of the objects in the universe and solar system, and by gaining a sense of the scale of the universe and solar system students can begin to gain a deeper understanding of it and Earth’s place within the system.

Lesson Level Performance Expectations

- Students can construct an argument using evidence that the sun appears larger and brighter than other stars because it is the closest star to Earth.
- Students can analyze data about stars to determine that stars range greatly in their distance from the Earth.
- Students can develop and use a model to demonstrate that the rotation of Earth on its axis between its North and South poles causes night and day.
• Students can **analyze data from observations** to reveal **patterns** in shadows.
• Students can **represent data in a graph or table** to determine the **patterns** in the changes of shadows over time.
• Students can **explain from evidence** that **patterns** in the length and direction of shadows are due to the rotation of Earth on its axis between the North and South Pole.
• Students can **chart lunar phases to reveal** that the changing phases of the moon occur in a **monthly cyclical pattern**.
• Students can **develop a model to explain** that the changing monthly cyclical phases of the moon are due to the orbit of the moon around Earth.
• Students can **plan and carry out investigations** to show that the revolution of the Earth around the Sun **causes predictable seasonal changes**.
• Students can **analyze and interpret data to develop an understanding** that as the **seasons change** so do the observable positions of the stars depending on the day, month, and year.
• Students can **plan and carry out an investigation** to demonstrate that the gravity of the Earth always pulls an object down towards its center.
• Students can **utilize data from investigations to support a claim** that the gravity of the Earth always pulls an object down toward its center.

<table>
<thead>
<tr>
<th>Misconceptions</th>
<th>Accurate Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The equator always has more daylight hours and the North Pole always has the fewest.</td>
<td>1. Changes in the orientation of earth’s axis with respect to the sun over a year causes the length of daytime to be longer in the northern hemisphere when the north pole is tilted toward the sun and longer in the southern hemisphere when the south pole is tilted toward the sun.</td>
</tr>
<tr>
<td>2. The orientation of Earth’s axis of rotation in respect to the sun does not change throughout the year.</td>
<td>2. The orientation of earth's axis of rotation with respect to the sun changes as the earth moves around the sun.</td>
</tr>
<tr>
<td>3. Stars and constellations appear in the same place every night.</td>
<td>3. The stars in the sky change as the Earth's position changes in relation to the sun.</td>
</tr>
<tr>
<td>4. We experience seasons because of the earth's changing distance from the sun (closer in the summer, farther in the winter).</td>
<td>4. The seasonal changes in air temperature are caused by changes in the intensity of energy from sunlight and changes in the number of hours that energy from sunlight is transferred, both of which are brought about by earth's annual movement around the sun. These are due to changes in the orientation of earth’s axis with respect to the sun over a year causes the length of daytime to be longer in the northern hemisphere when the north pole is tilted toward the sun and longer in the southern hemisphere when the south pole is tilted toward the sun.</td>
</tr>
<tr>
<td>5. The moon can only be seen during the night.</td>
<td>5. The moon is visible during the day.</td>
</tr>
</tbody>
</table>
6. The phases of the moon are caused by the shadow of the earth on the moon.
7. The phases of the moon are caused by the moon moving into the sun's shadow.

6-7. The phases of the moon are caused by the predictable motion of the moon around the Earth and the amount of sunlight reflected from the moon and the changing angles of the moon to the Earth.

References

- (AAAS Project 2061)
- [www.amasci.com/miscon/opphys.html](http://www.amasci.com/miscon/opphys.html)
5-LS2-2 Students who demonstrate understanding can:
Use models to explain factors that upset stability of local ecosystems.

5-ESS3-1 Students who demonstrate understanding can:
Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

In Lay Terms

Ecosystems have many components that exist together in a balance. When any component in an ecosystem changes it can influence the other parts of the ecosystem. These changes can have a positive or negative impact on the ecosystem. Some of these changes are due to humans using resources within the ecosystem. Today many communities are doing things to help protect and restore resources in ecosystems through wildlife conservation programs, sustainable farming practices, and city recycling programs.

Three Dimensional Storyline

In this bundle of performance expectations, students have opportunities to evaluate what makes an ecosystem healthy and factors that may or may not upset the health of an ecosystem. In determining the health of ecosystems or factors that may impact an ecosystem, students can collect data from observations or text in order to develop models of ecosystems and their components. When developing ecosystem models, students should consider all of the parts that are influencing the ecosystem and how those parts interact.

The use of models related to ecosystems should be a way for students to explain and make sense of phenomenon involved in the interactions within ecosystems. An example of a model could include a food web that highlights predator/prey relationships. This should help students begin to make predictions about how ecosystems may change when individual components of the ecosystem are affected either negatively or positively. Using models to understand the relationship of ecosystems and the components that make up an ecosystem can serve as a source of evidence when students construct arguments about the impact human activities have on ecosystems. Human communities are connected to ecosystems in many ways, although the primary connection exists in human’s use and protection of natural resources found in Earth’s various environments. For example, agricultural and industrial practices can greatly influence the health of a variety of ecosystems found on land, in streams, oceans, and the atmosphere.

Students can use reliable sources from text and media to investigate the practices and humans use to protect Earth’s resources and the environments they are found in (e.g. the use of natural fertilizers, replanting, and rotation of trees by the logging industry, as well as recycling programs).
Prior to this level, students can identify the parts of a working system. By the end of this level, students can better understand that in an ecosystem those individual parts, both living (biotic) and a nonliving (abiotic), work together and function as an (eco) system. All the individual parts of an ecosystem exist in a series of connected relationships to interact with and influence each other. The individual parts of an ecosystem work together to carry out functions, which have a larger impact on Earth and its other systems. For example, large forests influence the atmosphere by capturing and using carbon dioxide in photosynthesis. Living organisms have needs that must be met by the environment in which they exist in order to survive. Students should be able to explain, using evidence, the ways in which organisms are able to meet their needs within an ecosystem. When organisms are not able to meet their needs in an ecosystem, they cannot continue to survive in that specific environment.

Students can plan and carry out investigations in order to determine that an ecosystem is not always stable. When new species move into an already inhabited ecosystem, the balance within the system will be disrupted resulting in a change in the ecosystem and the relationships among its components. Students can use models to analyze the similarities and differences between these types of disruptions in an ecosystem and when humans influence a functioning ecosystem.

**Lesson Level Performance Expectations**

- Students can ask questions to investigate how organisms can only survive in environments in which their particular needs are met.
- Students can use evidence from investigations to explain that organisms survive only in environments where all their needs are met.
- Students can plan and carry out investigations in order to determine how a healthy ecosystem operates.
- Students can describe how a healthy ecosystem works.
- Students can analyze data used to develop a model to determine factors that upset the stability of local ecosystems.
- Students can develop and use a model to explain that when a new species is introduced, it can damage the balance of an ecosystem.
- Students can construct and support an argument that human activity has an impact on the Earth and outer space.
- Students can obtain and evaluate information about individuals and communities doing things to protect Earth’s resources and environments.
- Students can analyze data to evaluate the impact of individual communities’ use of science ideas to protect the Earth’s resources and environment.
<table>
<thead>
<tr>
<th>Misconceptions</th>
<th>Accurate Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plants need things provided by people (water, nutrients, light)</td>
<td>1. While people often care for plants (especially those indoors), plants as a</td>
</tr>
<tr>
<td>2. The Earth is too large for humans to have too much of an impact, either</td>
<td>whole are not dependent on people for their needs.</td>
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<tr>
<td>positive or negative.</td>
<td>2. Human beings have an enormous impact on the natural environment, and</td>
</tr>
<tr>
<td></td>
<td>ultimately on each other.</td>
</tr>
</tbody>
</table>

**References**

Resource Guide

Teacher Resources
Lesson Plan: Exploring Energy
Lesson Plan: Designing a Scale Model of the Solar System
Lesson Plan: Cycling Water Through the Environment

Professional Development Resources
Time to Teach Matter: The Science Penguin
Matter Lessons: Super Teacher Ideas
Essential Science for Science Teachers: Physical Science
Essential Science for Science Teachers: Earth and Space Sciences
Digital Resource: Weather and Climate Background
Digital Resource: Life Science

Student Resources
What’s the Matter in the Galaxy: Tutorial
Energy Story

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## Earth and Space Science-Fourth Grade

<table>
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<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-ESS1-1</td>
<td>Students who demonstrate understanding can: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.</td>
</tr>
<tr>
<td>4-ESS2-1</td>
<td>Students who demonstrate understanding can: Plan and conduct investigations on the effects of water, ice, wind, and vegetation on the relative rate of weathering and erosion.</td>
</tr>
<tr>
<td>4-ESS2-2</td>
<td>Students who demonstrate understanding can: Analyze and interpret data from maps to describe patterns of Earth’s features.</td>
</tr>
<tr>
<td>4-ESS3-1</td>
<td>Students who demonstrate understanding can: Obtain and combine information to describe that energy and fuels are derived from renewable and non-renewable resources and how their uses affect the environment.</td>
</tr>
<tr>
<td>4-ESS3-2</td>
<td>Students who demonstrate understanding can: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.</td>
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## Physical Science-Fourth Grade

<table>
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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>4-PS3-1</td>
<td>Students who demonstrate understanding can: Use evidence to construct an explanation relating the speed of an object to the energy of that object.</td>
</tr>
<tr>
<td>4-PS3-2</td>
<td>Students who demonstrate understanding can: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</td>
</tr>
<tr>
<td>4-PS3-3</td>
<td>Students who demonstrate understanding can: Ask questions and predict outcomes about the changes in energy that occur when objects collide.</td>
</tr>
<tr>
<td>4-PS3-4</td>
<td>Students who demonstrate understanding can: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.</td>
</tr>
<tr>
<td>4-PS4-1</td>
<td>Students who demonstrate understanding can: Develop a model of waves to describe patterns in terms of amplitude and wavelength and to show that waves can cause objects to move.</td>
</tr>
<tr>
<td>4-PS4-2</td>
<td>Students who demonstrate understanding can: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.</td>
</tr>
<tr>
<td>4-PS4-3</td>
<td>Students who demonstrate understanding can: Generate and compare multiple solutions that use patterns to transfer information.</td>
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</table>

## Life Science-Fourth Grade

<table>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-LS1-1</td>
<td>Students who demonstrate understanding can: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</td>
</tr>
<tr>
<td>4-LS1-2</td>
<td>Students who demonstrate understanding can: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.</td>
</tr>
</tbody>
</table>
### Earth and Space Science-Sixth Grade

<table>
<thead>
<tr>
<th>MS-ESS2-4</th>
<th>Students who demonstrate understanding can: Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-ESS3-3</td>
<td>Students who demonstrate understanding can: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.</td>
</tr>
</tbody>
</table>

### Physical Science-Sixth Grade

<table>
<thead>
<tr>
<th>MS-PS1-4</th>
<th>Students who demonstrate understanding can: Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-PS2-5</td>
<td>Students who demonstrate understanding can: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</td>
</tr>
<tr>
<td>MS-PS2-2</td>
<td>Students who demonstrate understanding can: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</td>
</tr>
<tr>
<td>MS-PS3-4</td>
<td>Students who demonstrate understanding can: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.</td>
</tr>
<tr>
<td>MS-PS3-3</td>
<td>Students who demonstrate understanding can: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.</td>
</tr>
</tbody>
</table>

### Life Science-Sixth Grade

<table>
<thead>
<tr>
<th>MS-LS1-1</th>
<th>Students who demonstrate understanding can: Conduct an Investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-LS1-3</td>
<td>Students who demonstrate understanding can: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</td>
</tr>
<tr>
<td>MS-LS2-1</td>
<td>Students who demonstrate understanding can: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.</td>
</tr>
<tr>
<td>MS-LS2-2</td>
<td>Students who demonstrate understanding can: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.</td>
</tr>
<tr>
<td>MS-LS2-3</td>
<td>Students who demonstrate understanding can: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.</td>
</tr>
<tr>
<td>MS-LS2-4</td>
<td>Students who demonstrate understanding can: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.</td>
</tr>
<tr>
<td>MS-LS2-5</td>
<td>Students who demonstrate understanding can: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</td>
</tr>
</tbody>
</table>