

OKLAHOMA ACADEMIC STANDARDS

SCIENCE FRAMEWORK

GRADE 5: OVERVIEW



OKLAHOMA STATE DEPARTMENT OF
EDUCATION
— CHAMPION EXCELLENCE —

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.¹ **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, Doug Paulson of the Minnesota State Department of Education who served as a consultant, Lawton Public Schools and to Quentin Bidy, the project director.

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“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

¹ Download the Oklahoma Academic Standards for Science at <http://sde.ok.gov/sde/science>.

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 Science² or check out the OKSci PD on Your Plan Module series, Transitioning to the Oklahoma Academic Standards for Science³.

Lesson Level Performance Expectations

This section aims at providing **scaffolding three-dimensional learning targets** that teachers can design instruction around to meet the end goal 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.

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/AUXXIQC11VZDeLmUkOMPpjhKeJjqS-R8gww>

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**.

Misconceptions

1. When matter disappears, it no longer exists.
2. Gas makes things lighter. Air has no weight,

Accurate Concept

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.

color or odor and is in effect invisible and inconsequential.

References

- http://www.rsc.org/images/Misconceptions_update_tcm18-188603.pdf
- <http://beyondpenguins.ehe.osu.edu/issue/climate-change-and-the-polar-regions/climate-misconceptions-a-top-10-list>

Bundle: Reactions and Properties of Matter

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.

Misconceptions

1. A chemical reaction always happens when two substances are combined together.

Accurate Concept

1. Not all substances react when combined.

References

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 obtain 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.

Misconceptions

1. All animals in an ecosystem get along with each other.
2. Plants are dependent on humans.
3. Plants cannot defend themselves.
4. Organisms higher in a food web eat everything that is lower in the food web.
5. Decomposers release some energy that is cycled back to plants.
6. Plants get their energy from the soil through roots.

Accurate Concept

1. Within an ecosystem, species compete for resources and feed on one another.
2. While people often care for plants (especially those indoors), plants as a whole are not dependent on people for their needs.
3. Plants have a range of defenses including external structures (sap, hairs, thorns, wax) and chemicals that either reduce digestibility or are toxic.
4. Organisms higher in a food chain eat some, but not necessarily all, of the organisms below them in the food web.
5. Decomposers break down dead organisms, returning nutrients to the soil so they can be used by plants. Some decomposers are eaten by carnivores.
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.

References

- <http://beyondpenguins.ehe.osu.edu/issue/tundra-life-in-the-polar-extremes/common-misconceptions-about-biomes-and-ecosystems>
- <http://beyondpenguins.ehe.osu.edu/issue/polar-plants/common-misconceptions-about-plants>

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

- http://hub.mspnet.org/media/data/MiTEP_List_of_Common_Geoscience_Misconceptions.pdf?media_000000007297.pdfh.
- https://serc.carleton.edu/NAGTWorkshops/intro/misconception_list.html
- <http://beyondpenguins.ehe.osu.edu/issue/polar-oceans/common-misconceptions-about-oceans#misconceptions>

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.

Misconceptions

1. The equator always has more daylight hours and the North Pole always has the fewest.
2. The orientation of Earth's axis of rotation in respect to the sun does not change throughout the year.
3. Stars and constellations appear in the same place every night.
4. We experience seasons because of the earth's changing distance from the sun (closer in the summer, farther in the winter).
5. The moon can only be seen during the night.
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.

Accurate Concept

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.
2. The orientation of earth's axis of rotation with respect to the sun changes as the earth moves around the sun.
3. The stars in the sky change as the Earth's position changes in relation to the sun.
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.
5. The moon is visible during the day.
- 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

Bundle: Human Interactions on Ecosystem and Earth

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.

Misconceptions

1. Plants need things provided by people (water, nutrients, light)
2. The Earth is too large for humans to have too much of an impact, either positive or negative.

Accurate Concept

1. While people often care for plants (especially those indoors), plants as a whole are not dependent on people for their needs.
2. Human beings have an enormous impact on the natural environment, and ultimately on each other.

References

- <http://beyondpenguins.ehe.osu.edu/issue/polar-plants/common-misconceptions-about-plants>
- <http://www.fewresources.org/ecological-footprints--human-impact-factors.html>

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