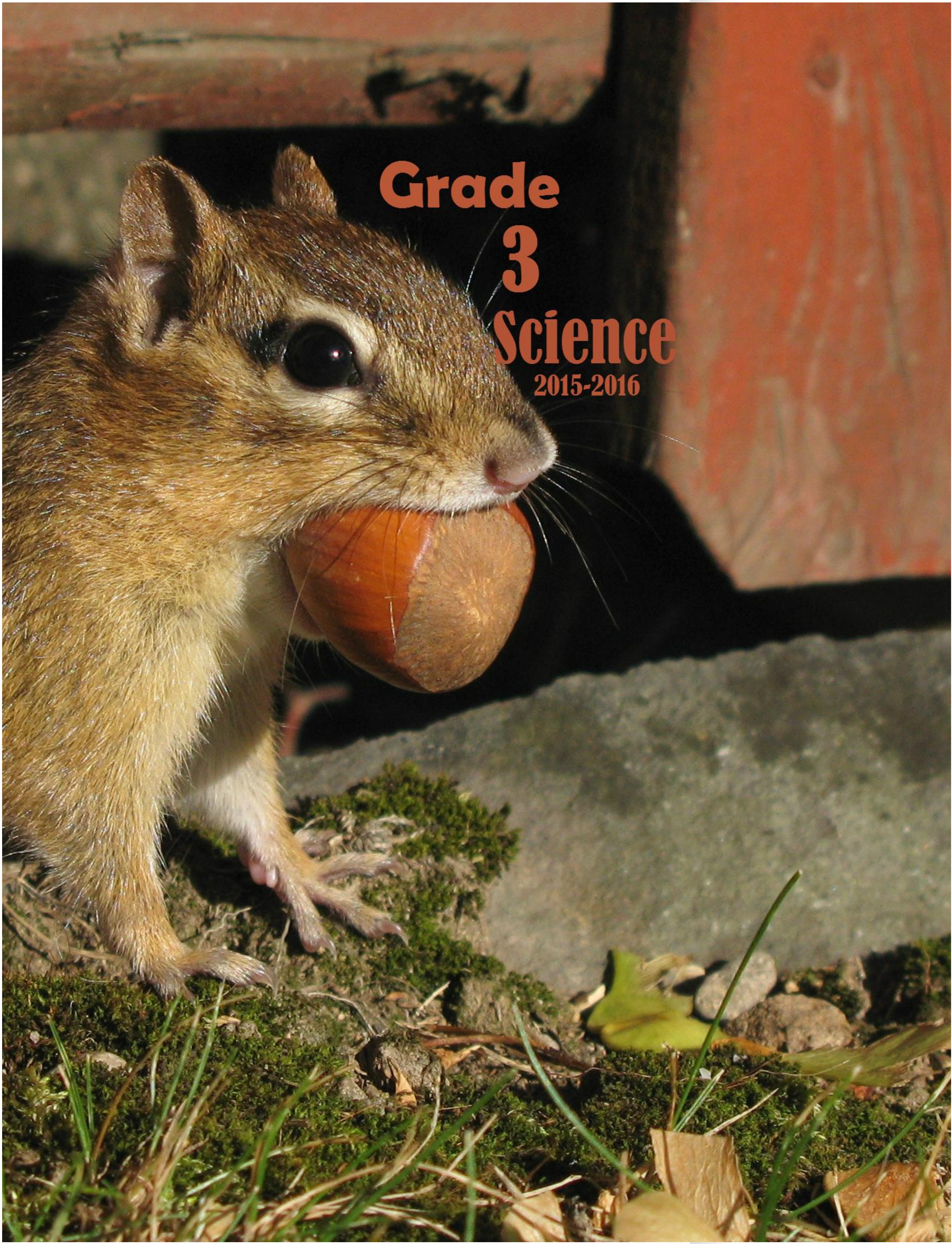

Grade 3 Science

2015-2016

Credits

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SIYAVULA
TECHNOLOGY-POWERED LEARNING

This book is all about science. It includes information for you to read, pictures for you to look at, and things for you to do. It also includes some questions you can think about as you learn about science.

It's your learning, it's your book.
Work Hard, Do Science, Have FUN!

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Utah Science Core Curriculum Alignment

Standard 1: Students will understand that the shape of Earth and the moon are spherical and that Earth rotates on its axis to produce the appearance of the sun and moon moving through the sky.

Objective 1: Describe the appearance of Earth and the moon.

a) Describe the shape of Earth and the moon as spherical.
b) Explain that the sun is the source of light that lights the moon.
c) List the differences in the physical appearance of Earth and the moon as viewed from space.

Objective 2: Describe the movement of Earth and the moon and the apparent movement of other bodies through the sky.

a) Describe the motions of Earth (i.e., the rotation [spinning] of Earth on its axis, the revolution [orbit] of Earth around the sun).
b) Use a chart to show that the moon orbits Earth approximately every 28 days.
c) Use a model of Earth to demonstrate that Earth rotates on its axis once every 24 hours to produce the night and day cycle.
d) Use a model to demonstrate why it seems to a person on Earth that the sun, planets, and stars appear to move across the sky.

Standard 2: Students will understand that organisms depend on living and nonliving things within their environment.

Objective 1: Classify living and nonliving things in an environment.

a) Identify characteristics of living things (i.e., growth, movement, reproduction).
b) Identify characteristics of nonliving things.
c) Classify living and nonliving things in an environment.

Objective 2: Describe the interactions between living and nonliving things in a small environment.

a) Identify living and nonliving things in a small environment (e.g., terrarium, aquarium, flowerbed) composed of living and nonliving things.
b) Predict the effects of changes in the environment (e.g., temperature, light, moisture) on a living organism.
c) Observe and record the effect of changes (e.g., temperature, amount of water, light) upon the living organisms and nonliving things in a small-scale environment.
d) Compare a small-scale environment to a larger environment (e.g., aquarium to a pond, terrarium to a forest).
e) Pose a question about the interaction between living and nonliving things in the environment that could be investigated by observation.

Standard 3: Students will understand the relationship between the force applied to an object and resulting motion of the object.

Objective 1: Demonstrate how forces cause changes in speed or direction of objects.

a) Show that objects at rest will not move unless a force is applied to them.
b) Compare the forces of pushing and pulling.
c) Investigate how forces applied through simple machines affect the direction and/or amount of resulting force.

Objective 2: Demonstrate that the greater the force applied to an object, the greater the change in speed or direction of the object.

a) Predict and observe what happens when a force is applied to an object (e.g., wind, flowing water).
b) Compare and chart the relative effects of a force of the same strength on objects of different weight (e.g., the breeze from a fan will move a piece of paper but may not move a piece of cardboard).
c) Compare the relative effects of forces of different strengths on an object (e.g., strong wind affects an object differently than a breeze).
d) Conduct a simple investigation to show what happens when objects of various weights collide with one another (e.g., marbles, balls).
e) Show how these concepts apply to various activities (e.g., batting a ball, kicking a ball, hitting a golf ball with a golf club) in terms of force, motion, speed, direction, and distance (e.g. slow, fast, hit hard, hit soft).

Standard 4: Students will understand that objects near Earth are pulled toward Earth by gravity.

Objective 1: Demonstrate that gravity is a force.

a) Demonstrate that a force is required to overcome gravity.
b) Use measurement to demonstrate that heavier objects require more force than lighter ones to overcome gravity.

Objective 2: Describe the effects of gravity on the motion of an object.

a) Compare how the motion of an object rolling up or down a hill changes with the incline of the hill.
b) Observe, record, and compare the effect of gravity on several objects in motion (e.g., a thrown ball and a dropped ball falling to Earth).
c) Pose questions about gravity and forces.
d) Language science students should use: distance, force, gravity, weight, motion, speed, direction, simple machine

Standard 5: Students will understand that the sun is the main source of heat and light for things living on Earth. They will also understand that the motion of rubbing objects together may produce heat.

Objective 1: Provide evidence showing that the sun is the source of heat and light for Earth.

a) Compare temperatures in sunny and shady places.
b) Observe and report how sunlight affects plant growth.
c) Provide examples of how sunlight affects people and animals by providing heat and light.
d) Identify and discuss as a class some misconceptions about heat sources (e.g., clothes do not produce heat, ice cubes do not give off cold).

Objective 2: Demonstrate that mechanical and electrical machines produce heat and sometimes light.

a) Identify and classify mechanical and electrical sources of heat.
b) List examples of mechanical or electrical devices that produce light.
c) Predict, measure, and graph the temperature changes produced by a variety of mechanical machines and electrical devices while they are operating.

Objective 3: Demonstrate that heat may be produced when objects are rubbed against one another.

a) Identify several examples of how rubbing one object against another produces heat.
b) Compare relative differences in the amount of heat given off or force required to move an object over lubricated/non-lubricated surfaces and smooth/rough surfaces (e.g., waterslide with and without water, hands rubbing together with and without lotion).

Why Science?

Many students believe science is limited to learning vocabulary terms, labeling pictures, and memorizing facts. Science by nature is much more than this. Have you ever wondered how or why something in nature happens? You might even ask questions about it. This is science. Science works best when it starts with curiosity and includes innovation. We learn science best when we apply it to our everyday lives. Science is not only learning about space and living things. However, there are cross-cutting concepts connecting all scientific ideas. These include:

- Patterns; such as phases of the moon.
- Cause and effect: Mechanism and explanation; such as gravity, forces and motion.
- Scale, proportion, and quantity; such as measuring differences in temperature.
- Systems and system models; such as how a terrarium resembles nature.
- Energy and matter: Flows, cycles, and conservation; such as different sources of heat and light.
- Structure and function; such as simple machines.
- Stability and change; such as characteristics of living and non-living things.

When studying science it helps to keep these cross-cutting concepts in mind. We can use them to connect ideas and gain a better understanding of the world of science. Included in the concepts are the skills and practices that scientists and engineers use. You can use these practices, too. When asking questions about the natural world, certain skills and practices can help you. We can generate better conclusions, explanations and inferences. These practices include:

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions

- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Learning these cross-cutting concepts is easier when we have a specific idea or question. For example, if you study space without the cross-cutting concepts and scientific practices then you limit yourself. You may only memorize facts and miss how these concepts relate to our everyday life. Studying space or plants can help us understand cross-cutting concepts and gain scientific skills. Those skills make science more meaningful, and allow you to become the scientist.

For example, when learning about energy from the sun, scientists can develop new ways to create electricity that are less harmful to the environment. However, they must collaborate with engineers to build the structures. They must consult with city officials to see where power is needed. They must study weather patterns to determine the best placement for solar panels or wind farms. Another consideration is protecting animal and plant habitats. A scientist only focused on power might miss something important in this process.

Earth, sun and moon

chapter 1

Standard 1, Objectives 1 and 2

How do the Earth, Sun, and Moon Appear in Space?

Quick! What is the second brightest object in the sky? You know the Sun is the brightest object. Did you guess the **moon-** a natural, rocky object that goes around a planet- is the second brightest? You're right! When viewed from Earth, the **moon** looks like it is glowing. The moon doesn't make its own light, though. So, what makes it shine in the sky? As the sun's light shines on the moon, light bounces off the moon's surface and to our eyes. This makes the moon seem to glow. Earth does the same thing. If you were standing on the moon looking down at Earth, you would see the sun's light bounce, or **reflect-** to bend or throw back light waves- off Earth. In fact, light **reflects** off all the other planets and moons in our solar system. That's how we know they are there. We can see the Sun's light reflecting off them. In fact, the sun's light is responsible for nearly all the light in our solar system.

Moon reflecting sunlight
https://solarsystem.nasa.gov/planets/profile.cfm?Object=Moon

Earth from space
https://solarsystem.nasa.gov/planets/profile.cfm?Object=Earth

Do you think that Earth and the moon have the same **appearance-** the way something looks- as seen from space? Do you think they look different? What does Earth look like from space? You can see the land, the water, and the clouds that surround it in the air when looking at Earth from space. Since Earth has more water than land, it looks blue.

What do you think the moon looks like from space? From space, you can see hundreds of shallow holes made from rocks falling onto the moon's surface. You can also see mountains made from volcanoes and dark patches made from lava. The moon looks light gray from space because it has no water or air. How do Earth and the moon **appear** the same? If you guessed that they are both spheres, you are correct. One difference you might notice is that the moon is much smaller than Earth. Earth appears to be about four times larger than the moon.

The Moon is ¼ the size of Earth. (http://photojournal.jpl.nasa.gov/jpegMod/PIA00342_modest.jpg)

Another object we see in our sky each day is the sun. We could not live without it. We see the sun rise at the beginning of the day and set at the beginning of the night. However, the sun always stays in the same place. Have you ever wondered why the sun seems to be moving in the sky? Have you ever wondered why we have night and day? Look at the picture of Earth.

Day and night on Earth
http://photojournal.jpl.nasa.gov/jpegMod/PIA00232_modest.jpg

Since Earth is round, sunlight can only shine on half of Earth at one time. Earth doesn't stay still. Earth rotates or spins around on an axis -an imaginary line that goes through the center of a planet. This rotation–the spinning of an object (planet) around its own axis–brings the sun into our view in the morning; we call this a sunrise. As Earth continues to rotate, the sun seems to move across the sky. Finally, the rotation of Earth takes the sun out of our view in the evening; we call this a sunset. In a few hours, as Earth continues to rotate on its axis, the sun will seem to come up again. The time it takes Earth to make a full rotation is 24 hours or one day.

The rotation of Earth brings the sun in and out of view. When the sun is out of view and dark, what do you see in the sky? Yes! Stars appear in the night sky. Have you ever watched those stars closely at night for a couple of hours? If you have, you probably noticed that some seem to be moving across the sky. Some stars go in and out of view, setting and rising like the sun. What do you think is happening? It is the rotation of Earth that makes them seem to appear to be moving across the sky.

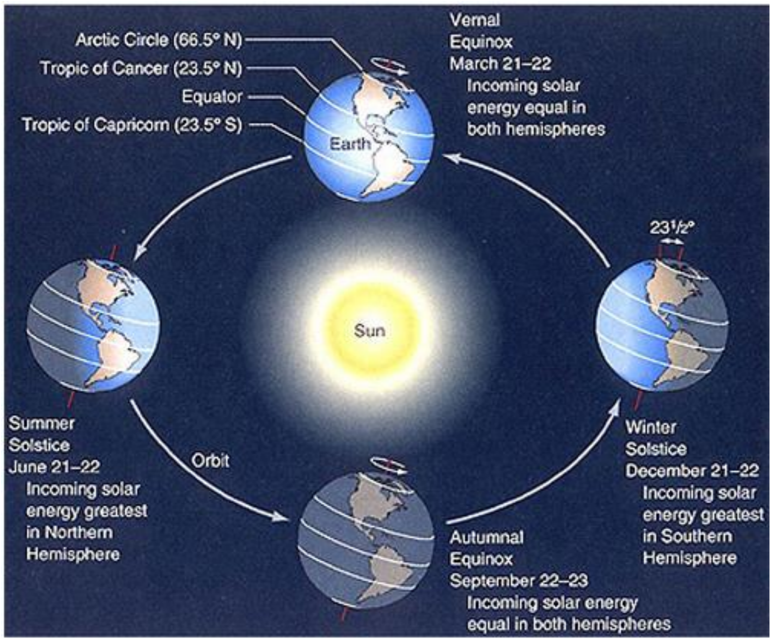
As Earth rotates, causing night and day, it also takes a long journey around the sun. This yearly journey is called a revolution. This revolution takes 365 days, or one year. On its journey around the sun, Earth follows an orbit, the path an object in space follows as it revolves around another object. We can understand these ideas of rotation and revolution better by using a globe of Earth as a model- a small-sized copy of something. Mark your location on the globe. Put a lamp with its shade off in the middle of a room. Turn on the lamp light. Hold the globe in the air about ten feet away from the lamp. Slowly spin it. This represents Earth rotating on its axis. What do you notice about the light on the globe? As the globe rotates, the light shines on different parts of the globe while other parts are dark. This model shows how we get night and day from the rotation of Earth. Can you see when your location is in sunlight? This would be daytime for you. Now follow the rotation to see your location experience sunset and night time. Remember, Earth rotates on its axis once every 24 hours to produce the night and day cycle.

http://tinyurl.com/UT3rd1-1photo by Kevin Gill
Earth's day and night are caused by its rotation every 24 hours.

View of Earth from Moon
http://solarsystem.nasa.gov/multimedia/display.cfm?Category=Planets&IM_ID=1793

Our model can also show Earth's revolution around the sun. With the globe in hand, walk around the lamp in a circle, and stop where you started. This represents Earth's revolution around the sun. It takes Earth about 365 days to go around the sun. What do we call this period of time? That’s right, it’s one year. If you were to continue to walk around the lamp in the same path, this would represent Earth's orbit–the path an object in space follows as it revolves around another object.

Using the same model, hold a star behind the globe about twenty feet away from the globe. Now, spin the globe. If we were on the globe, when would we be able to see the star? What does the star seem to be doing as Earth rotates? As the globe spins, the star seems to move across the night sky. Stars can be seen all over the sky. However, they are only visible at night because the sun is too bright for the stars to be viewed during the day.



"Revolution of Earth around the Sun"
http://solarsystem.nasa.gov/multimedia/display.cfm?Category=Planets&IM_ID=6764

Let's find out more about the moon. Possibly you have noticed that sometimes the moon is up during daylight hours. Sometimes it is up during nighttime hours. This is because the moon orbits the earth. The earth and moon then orbit around the sun. This double orbit causes the moon to be visible at different times of day.

The moon can be seen in the daytime as well as at night. http://asd.gsfc.nasa.gov/archive/tiger/images/moon_sm.jpg

The moon moves around Earth in an orbit just as Earth moves around the sun. When the moon has made one complete circle around Earth, it too, has made a full revolution. The revolution of the moon orbiting Earth takes about twenty-nine days.

As Earth rotates on its axis, the moon goes in and out of our view each day just like the sun and stars do. Therefore, the moon seems to rise, move across the sky, and set. Because the moon orbits around Earth, it appears and disappears at different times from our view each day. Each day, when we see the moon, it has orbited around Earth a little more. This makes the moon come up at a different time each day.

You can make a model of the moon orbiting Earth. With the lamp in the middle or the room, have a student hold the globe while another student slowly revolves around the globe with a small ball representing the moon in hand. Can you see how the moon seems to move across the sky after coming into view? As the student with the ball is revolving around the globe, can you see how sometimes the moon can be seen during the day and sometimes at night? When the ball returns to the same place it began, this represents a full revolution of the moon around Earth. Using a model can help us understand science.

Think like a Scientist

1. What are some ways the Earth and the moon appear the same when viewed from space? How do they appear different?

2. What makes the moon shine?

3. Explain what causes night and day on Earth.

4. Describe Earth's revolution. What does it revolve around? How long does it take?

5. Give details about the moon's revolution.

6. Why does the sun change position in the sky?

7. What is actually happening at sunrise? At sunset?

Online Interactive Activities

- http://tinyurl.com/UT3rd1-1a Earth, sun, and moon mystery
- http://tinyurl.com/UT3rd1-1b Earth and moon rotation and revolution
- http://tinyurl.com/UT3rd1-1c Name the phases of the moon

- http://tinyurl.com/UT3rd1-1d Thunderbolt Kids The Moon
- http://tinyurl.com/UT3rd1-1e Thunderbolt Kids Earth and Sun
- http://tinyurl.com/UT3rd1-1video1 Ck12 Earth's Shape (less advanced)
- http://tinyurl.com/UT3rd5-1link The Moon, NASA

Science Language Students Need to Know and Use

1. **appearance:** the way something looks
2. **axis:** an imaginary line that goes through the center of a planet
3. **model:** a small-sized copy of something
4. **moon:** a natural, rocky object that goes around a planet
5. **orbit:** the path an object in space follows as it revolves around another object
6. **reflect**: to bend or throw back light waves
7. **revolution:** one orbit of an object in space around another object in space
8. **rotation:** the spinning of an object (planet) around its own axis

Supporting vocabulary for ELL

1. **object**: a thing that can be seen or touched
2. **shallow**: not very deep
3. **produce**: to make or cause something
4. **cycle**: a set of events or steps that are repeated in the same order
5. **represent**: to serve as an example or model of something

Books

- *Somewhere in the World Right* Now by Stacey Schuett, Dragonfly Books 1997
- *Twilight Comes Twice* by Ralph Fletcher, Clarion Books 1997
- *Next Time You See a Sunset* by Emily Morgon, NSTA Press 2003
- *The Moon Book* by Gail Gibbons, Holiday House 1998
- *The Moon* by Seymour Simon, Simon & Schuster Books for Young Readers 2003

Living and Nonliving Things

chapter 2

STANDARD II: Students will understand that organisms depend on living and nonliving things within their environment.

What is Alive? What is Not Alive?

Be a scientist! How would you sort the items below using their properties? Some properties you might notice are color and size. But could you organize them according to whether they are living or nonliving?

https://www.flickr.com/photos/kapkap/274808215/

http://www.forestwander.com/2012/05/hippie-flower/

When we explore on the playground, we see all sorts of exciting things. Some of the things in the photos are living, and others are nonliving. Sometimes it is easy to tell if something is living or nonliving. A dog moves, grows, and can reproduce - have babies- so dogs are living. A rock does not move on its own, does not grow or have babies, so a rock is nonliving. What about plants? Even though plants don't play catch, they still grow and reproduce, so plants are living things. Another word for living things is organism- an individual life form. An organism is anything that grows, moves, and reproduces.

When we put things into groups, we are classifying– sorting things according to their properties. Sometimes it is difficult to classify things as living and nonliving. That is why we also classify things as once living or having the potential for life. What about things like leather shoes or a salad at lunch? These both were made from plants or animals, but they don't move, grow, or reproduce, so they are once living. The seed in your apple may not look like a living thing, but it has the potential for life. If we dig a hole, plant the seed in soil and give it plenty of water, it could grow into a giant apple tree. Then you can eat the apple when it is ripe!

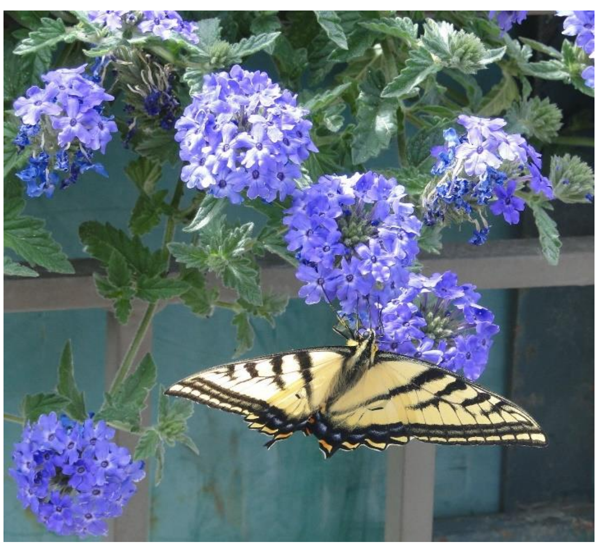


Photo by J. Paul

These living things move, grow, and reproduce.

How Do Organisms Use Their Environment?

How are these organisms interacting with their surroundings?

Environments are places where plants and animals live. Every environment has both living and nonliving things in it. The living things in an environment include the plants and animals you can see, and some that may be more hidden. For example, we are likely to notice the large trees in a forest, but less likely to find the tiny mushrooms that grow under the fallen leaves. These are both examples of living things in a forest. Some animals also play hide and seek with us in their environments. Large animals like elk, red-tailed hawks, and squirrels can be easier to spot. You have to look closely to find earthworms, insects, and tiny hummingbirds.

The nonliving parts of an environment play an important role as well. You know that the soil in the forest is important. This nonliving material provides a place for plants to grow and animals to hide. Water is another nonliving material found in the forest. Without it, plants and animals couldn't survive. Have you considered that air and sunlight are also nonliving parts of every environments? Without these two nonliving components, nothing on Earth would be able to live.

Environments can be large or small. Large **environments,** such as forests, can be difficult to study because they contain many organisms, or living things. Often environments that are **small-scale**-something small in size, can be studied instead. A flowerbed in your backyard is an example of a **small-scale** environment. An even smaller environment would be a **terrarium**-a container with soil where land plants and animals are kept. **Terrariums** help us study land environments like deserts and forests.

When scientists want to learn more about how living and nonliving things interact in an environment, they can use a small-scale model of the environment. This way, they can control the things in the model in ways they couldn't control a whole forest or pond.

Terrarium with land plants. Some terrariums also contain land animals. (http://www.flickr.com/photos/cmichel67/8191287403/)

Another type of small-scale environment is an aquarium- a container filled with water and water plants and animals. Aquariums help us learn about other water environments like ponds and oceans.

Aquarium with water animals and plants
(http://flickr.com/photos/95118988@N00/131669195)

Aquariums and terrariums are used to study environments. We can observe how living things interact with each other and with the nonliving things in their environment. Organisms, including people, are always interacting with the nonliving parts of their environment. Along with light, moisture and air, temperature is an important part of every environment. These nonliving parts of the environment can determine what happens there. Have you ever seen a polar bear in a desert? That's because the desert is not the right type of environment for a polar bear! The temperature is too warm. Organisms like to be comfortable in their environment. If a plant or animal is not adapted to its environment it will not survive.

What can an organism do if the environment changes? Some animals move to a new environment. Plants cannot move around. Plants must “move” by spreading their seeds. Sometimes plants spread their own seeds. Some seeds can be spread by wind, water, or animals.

Scientists study ways the environment changes over time. They look for ways to help plants and animals survive the changes. This work may help us protest ourselves and the environment we live in, too.

Photo by J. Paul

Plants and animals interact with nonliving things in the environment.

Think Like a Scientist

1. In a terrarium, would worms prefer living in moist soil or dry soil? Set up a terrarium to observe and collect data.

2. What observations would you use to tell the difference between a living organism and a nonliving object?

3. Why do most aquariums use a bubbler, small device that bubbles air through the water?

4. How could you determine how much light plant needs?

5. Why is it easier to study a small-scale environment, like a terrarium, rather than a large scale one, like a forest?

6. What are some other interactions you could observe in a small-scale environment?

7. Compare and contrast living and non-living things

8. How do you think scientists sort living things?

9. Are there other living things besides plants and animals?

10. Identify some ways that we adjust to changes in our environment.

Online Interactive Activities

- http://tinyurl.com/UT3rd2-1video Is it living or nonliving?
- http://tinyurl.com/UT3rd2-1a Can you classify living things?
- http://tinyurl.com/UT3rd2-1b Living and nonliving things in the forest
- http://tinyurl.com/UT3rd2-1c Habitat game

- http://tinyurl.com/UT3rd2-1d Build a habitat online
- http://tinyurl.com/UT3rd2-1e Can you complete the food chain or web?
- http://tinyurl.com/UT3rd2-1f What does it eat?
- http://tinyurl.com/UT3rd2-1g Which animals fit?
- http://tinyurl.com/UT3rd2-1h Is it living, once living, or never alive?

Science Language Students Need to Know and Use

1. **living** - able to grow, reproduce, and move
2. **nonliving** - not able to grow, reproduce, or move
3. **organism** - anything that is living
4. **aquarium** - a container filled with water and water plants and animals
5. **environment** - the living and nonliving things in an area
6. **interaction** - things acting upon one another
7. **observe** - see or sense with careful study
8. **small-scale** - something small in size
9. **temperature** - how hot or cold something is
10. **terrarium** - a container with soil where land plants and animals are kept

Supporting Vocabulary for ELL

1. **reproduce** – have young or babies
2. **container** – an object that can hold something else
3. **adapt** – to change in a way that allows an organism to live in a different place
4. **desert** – an area on Earth that is very dry, usually getting less than 10 inches of water per year
5. **forest** – an area on Earth that supports many trees and other plants
6. **wetland** – an area on Earth where water loving plants and animals can live such as a pond or the banks of a river.

Books

- *What's Alive?* By Kathleen Zoehfeld, Harper Collins 1995
- *Living and Nonliving* by C. Lindeen, Capstone Press 2008
- *Is It a Living Thing?* By B. Kalman, Crabtree 2008
- *Is it living or nonliving?* By R. Rissman, Heinemann Library 2009
- *Living and nonliving* by A. Royston, Heinemann Library 2008
- *How Do Animals Adapt?* By B. Kalman and K. Walker, Crabtree 2000
- *Butternut Hollow Pond* by Brian J. Heinz, Millbrook Press 2000

Forces and motion

chapter 3

What is the difference between a Push and a Pull?

Objects are lazy! They do not move unless a **force**-a push or a pull- is applied to them. A push is a **force** that moves objects away from you. A pull is a force that moves objects toward you. Imagine a bowling ball sitting on the floor. Since it is heavy, it will stay where it is unless you apply a push or a pull. If you take your hands and push the ball, it will begin to roll. You are applying a force by pushing the ball. The force you apply will cause the ball to move.

A pull is the opposite force of a push. A pull is a force that comes toward you. It's boys against girls in the friendly game of tug-of-war pictured below. The two teams are pulling the rope in opposite **directions**-paths in which things travel. Which team do you think will win? It depends on which side pulls on the rope with the greatest force.

These students are using a force to cause motion.

You use push and pull forces many times during the day. During recess, you can watch closely as your classmates play. What activities require a push or pull? How many times do they push or pull? They may be batting, kicking, or throwing a ball. The amount of force they apply to the ball can change the direction and distance the ball will travel. You will be surprised how often you and your friends use these forces.

How do forces move objects?

Lift a basketball in one hand. The force of this pull moves the ball off the ground and keeps it from falling. Now lift a ping pong ball. The force needed to lift, or pull the ping pong ball and keep it from falling is far less than the force needed to lift, or pull the basketball. That’s because the basketball has more mass. Objects with more mass require more force to move, to turn, and to stop.

A large truck has more mass than a small car. If they collide, what do you think will happen? The truck has so much mass that it may continue to move forward. The small car will be pushed back or to the side because it has less mass. You can try this using two balls of unequal size, like a basketball and a ping pong ball. Roll the basketball and the ping pong ball toward each other. What happens when they meet? Yes, the ping pong ball is pushed back by the mass of the larger basketball.

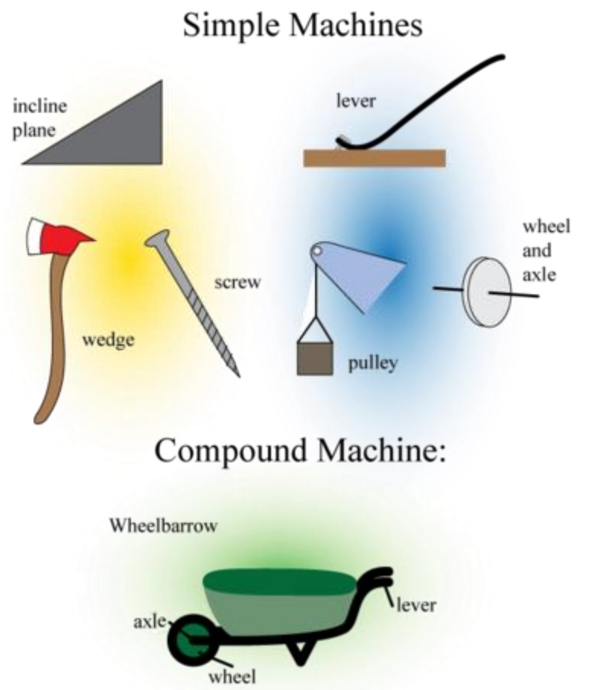
Not only do objects need forces applied to them to move, they need forces applied to stop moving or to change directions. When you throw a ball to your friend, the ball stops moving because it meets a force: your friend’s hand. If your friend misses the ball it doesn’t go on forever. Other forces act on it too. Gravity pulls it toward the ground. Friction between the ball’s surface and the air or ground slow it down. Soon the ball will roll to a stop because of these forces. To change the direction of a moving ball you might try kicking it or hitting it with a bat. This applies another force which causes the ball to move in a different direction.

by USAG-Humphreys

http://tinyurl.com/UT3rd2-1photo

How do simple machines help us apply force?

Some objects are just too hard for us to move on our own. Imagine having to move a very large rock out of a garden. You may not be able to lift the rock by yourself. Maybe you can get a friend to help you. That way, two people are each moving half the weight-measure of the force of gravity on an object-of the rock. But there is a tradeoff. You and your friend both have to move the rock out of the garden. You both have to walk, while holding onto the rock. So you are each doing one half of the work. The amount of work is still the same. You just split it up. That still might not be enough help. You can try breaking the rock into pieces and moving each piece separately. Of course, you are still doing the same amount of work. Each piece of rock requires you to pick it up and carry it out of the garden.



http://tinyurl.com/UT3rd3-1link

Another way to move the rock from the garden is to use a **simple machine**-a tool with no moving parts used to make work easier. You can use a ramp or a lever to move the rock, but there will be a tradeoff. Can you think what it might be? Yes. You will have to move the rock farther if you use a ramp. So you might choose to use a lever, which looks like a teeter-totter. Imagine putting one end of a teeter-totter under the rock. Now, push down on the other side. The rock will move more easily, but the tradeoff is that the rock will only rise a short distance while you must push down on the other side a very long **distance**-space between two places. **Simple machines** can certainly help us with work, but they can't make the work go away.

What other forces can move an object?
Of course, humans can move objects by pushing or pulling them. You do it every day. What other forces can move objects? Moving water can. Imagine a river rushing down a mountain. What does the water carry with it? You may see leaves, small rocks and sand, branches, and soil. All of these materials need a force to move them. The force of the water moves them downhill.

The **speed-** how fast or slow something is moving- will affect what objects are moved. If the water is moving very slowly, small objects can be moved. If the water moves quickly, what do you think will happen? Yes, larger objects can be moved. The **speed** of the water will determine which objects are moved.

Wind can do the same thing. When the wind is blowing slowly, it can move small bits of material. When it is moving fast, it will move much more material. Blowing sand can help carve the arches and canyons we see in Utah. The wind moves many things. Check out the flag at the front of your school. It may hang down on a calm day. When the wind blows softly it will rustle a bit. But when the wind blows hard, the flag will fly straight out from the mast. The air particles push against the flag, making it move.

A flag in calm air https://www.flickr.com/photos/ldysw357/with/1584088126/

A flag in strong wind https://www.flickr.com/photos/rwkphotography/

Think like a Scientist

1. Explain the difference between a push and a pull. Give two examples of each.
2. Describe one way to move a ball. Tell what force is being used.
3. When we move objects, which will require more force: a large, heavy object or a small, light object? Why?
4. Objects need forces to start them moving. What are some other ways objects are affected by forces?

Online Interactive Activities

- http://tinyurl.com/UT3rd3-1video Eureka! Simple Machines
- http://tinyurl.com/UT3rd3-1b Amusement park builder
- http://tinyurl.com/UT3rd3-1c Rollercoaster physics
- http://tinyurl.com/UT3rd3-1d What simple machine is it?
- http://tinyurl.com/UT3rd3-1e Soccer anyone?
- http://tinyurl.com/UT3rd3-1f Tinker ball!
- http://tinyurl.com/UT3rd3-1g Messing around with simple machines
- http://tinyurl.com/UT3rd3-1g Help Twitch build a robot.

Science Language Students Need to Know and Use

1. **direction** - a path that something travels
2. **force** - a push or pull
3. **motion** - a change of position
4. **gravity** – an invisible force that pulls objects toward each other
5. **simple machine** - a tool with no moving parts used to make work easier such as a lever, inclined plane, or pulley
6. **speed** - how fast or slow something is moving
7. **weight** - a measure of the force of gravity on an object

Books:

Fiction

- *The Marvelous Inventions* of Alvin Fernald by Clifford B. Hicks
- *Stranded* by Jeff Probst
- *My Side of the Mountain* by Jean Craighead George
- *Simple Story of the 3 Pigs and the Scientific Wolf* by Mary Fetzner
- *Lance Dragon Defends His Castle with Simple Machines* (In the Science Lab) by Eric Braun and Anthony Briglia

Nonfiction

- *A Crash Course in Forces and Motion with Max Axiom, Super Scientist* by Emily Sohn, Capstone 2007
- *Forces Make Things Move* by Kimberly B. Bradley, HarperCollins 2005
- *Forces and Motion: A Question and Answer Book (Questions and Answers: Physical Science* by Catherine A. Welch, Capstone 2007
- *Simple Machines* by Vijaya Khisty Bodach, Perfection Learning 2006

chapter 4

Gravity

What is Gravity?

Jump up in the air and you will fall back down again. Have you ever tried to stay up in the air and not fall back again? Try to stay up in the air. Flap your arms a little and see if it helps. Can you do it? Probably not! That's because of an invisible force- a push or pull- called **gravity**- the force that pulls objects toward the center of the earth. You can't see it, but gravity is a powerful force that affects all things.

What keeps this climber in the air?

http://tinyurl.com/UT3rd4-1photo

Earth's gravity is strong and pulls on objects without touching them. As you stand still or run as fast as you can, Earth's gravity is pulling down on you all the time. Skyscrapers, elephants, apples, and even you cannot get away from Earth's gravity! Even when you jump up into the air and you are not touching the ground, Earth's gravity is still pulling on you!

Mass is the amount of material that is in an object.

Some people confuse **mass** with **weight -** the amount of gravity pulling on the mass. How much do you weigh? You can step on a scale and measure your weight. Gravity pulls you down onto the scale which shows your weight. Without gravity, you would not have weight but you would still have mass. If you try to pick up heavy objects, it might hard to lift them. Lifting overcomes the pull of gravity, so you'd need a stronger force to lift a heavier object. Look around your classroom. What do you think is the heaviest thing around? Do you think it would be easy or hard for you to lift?

You can lift lighter objects more easily than heavier objects. But be careful, once you stop lifting, gravity will pull the object back to the ground no matter how heavy or light it may be.

For many years, people thought that heavier objects would fall faster than lighter ones. Galileo, a famous scientist, asked: "Do all objects fall at the same rate?" A story says that he dropped two different sized iron cannon balls off the Tower of Pisa. Many people watching were surprised to see they both reached the ground at the same time. They thought the heavier cannon ball would hit the ground first. This demonstration showed the importance of using experiments to find out answers to questions.

Bathurst Gravity Festival (Newton's Playground by Mountain/\Ash

How is gravity helping these riders?

Activity

Gather some small objects from around your home or classroom. You might find paper, pencils, erasers, small rocks, balls, and paper clips. Now, choose two objects that are the same mass, such as two identical pencils. Drop those two objects from the same height at the same time. This is more difficult than it sounds. You may have to practice several times before you can drop them both exactly at the same time. Watch to see how they hit the ground at the same time. Now try two objects that are not the same mass like a paper clip and a rock. Make a prediction about how they will land. Will the paper clip land first? The rock? Or will they land at the same time? Keep trying pairs of objects. Does anything surprise you? Try this: Choose two pieces of paper that are the same size and mass. Crumple one into a ball. Now, drop both the flat paper and the crumpled paper at the same time. What happened? You may notice that the crumpled paper lands first. The flat paper may sail around for a moment before touching the ground. It acts like a paper airplane. This is because air is pushing against it. The surface of the flat paper is much larger than the surface of the crumpled paper. There is a lot more air pushing up on the flat paper and much less air pushing up on the crumpled paper. The air slows the flat paper down. What other objects may also act this way? You might want to try a feather or a balloon.

Working against gravity

Air slows down falling objects on Earth. Some objects, such as feathers, fall slowly through the air. The shape of some objects make it easier for the air to work against the force of gravity to slow their fall. Gravity pulls all objects toward the center of Earth no matter their mass. Air can slow an object, but it can't stop gravity.

The air slows down this skydiver because his parachute has so much surface area.

http://www.ck12.org/physics/Acceleration-Due-to-Gravity/lesson/Acceleration-Due-to-Gravity-Intermediate/

When objects are moving, gravity still pulls them toward Earth. If you drop a baseball, gravity will pull it straight down to the ground. What happens when you throw the same ball to your friend? The ball doesn't drop straight down. Even though the ball is falling downward due to the force of gravity, it also

moves forward because of the forward force of your throw. Because of the forward motion and the work of gravity, the ball follows a curved path to the ground.

The pull of gravity
http://www.ck12.org/physical-science/Einsteins-Concept-of-Gravity-in-Physical-Science/lesson/Einsteins-Concept-of-Gravity/

Roll a ball across the floor. What are you using as a force? That's right, you are pushing the ball using your muscles. Pushing with your muscles causes the ball to move forward. Now place the ball at the top of a ramp. Let go and watch what happens. What force is moving the ball this time? Yes, the force of gravity pulls the ball down the ramp. What if you raise the height of the ramp? Try it and see. The ball will move down the ramp faster. You can make a graph to show how the height of the ramp affects the speed of the ball as it rolls.

Think like a Scientist:

1. What is gravity?
2. What is mass? What is weight? How are they the same? How are they different?
3. Does gravity push or pull objects? Give an example.
4. How are gravity and weight related?
5. Why is gravity important?
6. Is the force of gravity the same for heavy and light objects? Explain.

Online Interactive Activities

- http://tinyurl.com/UT3rd4-1a What do you weigh on Mars?
- http://tinyurl.com/UT3rd4-1b Ready, aim, fire!

Science Language students Need to Know and Use:

1. **force** - a push or pull
2. **gravity** - a force that pulls objects down toward the center of the earth
3. **weight** - the amount of gravity pulling on a mass
4. **mass** – the amount of matter something is made of

Supporting vocabulary for ELL

1. **overcome** – succeed in dealing with a problem
2. **demonstration** – the process of showing something.
3. **prediction** – best guess based on evidence; a hypothesis
4. **ramp** – a tilted surface

Books:

Fiction

- *Gravity Buster: Journal of a Cardboard Genius* by Frank Asch,
- *Astronaut Academy: Zero Gravity* by Dave Roman
- *Cal and the Amazing Anti-Gravity Machine* by Richard Hamilton
- *Simon Bloom, the Gravity Keeper* by Michael Reisman

Nonfiction

- *Gravity Is a Mystery (Let's-Read-And-Find... Science: Stage 2)* by Franklyn Mansfield Branley and Edward Miller
- *Up, Down, All Around: A Story of Gravity (Science Works)* by Jacqui Bailey
- *Gravity: Forces and Motion (Do It Yourself)* by Rachel Lynette
- *Cosmic Science: Over 40 Gravity-Defying, Earth-Orbiting, Space-Cruising Activities for Kids* by Jim Wiese

Videos (both available at UEN eMedia)

- The Magic School Bus Gains Weight
- Things in Motion

Heat and light

chapter 5

STANDARD V: Objective 1
Cause and Effect and Sequence

Why Do We Need the Sun?

Have you ever been inside a cave? What did it feel like? What did it look like? Caves block out sunlight so they are usually cool and dark. Sunlight provides the earth with light and **heat**- higher **temperatures**. A **heat source** is anything that creates heat. Sunlight is an important **heat source** for many reasons. Without sunlight, our Earth would be extremely cold and dark.

When it is very warm and sunny outside, we can stand in the shade of a tree to cool off. Why do you think this happens? The **temperature**- amount of **heat** present- in the shade is different from the **temperature** in the sunshine. The sun is the main source of heat, warmth, and light for organisms living on Earth. Without the sun, many living things could not survive. Living organisms use heat and light from the sun. Some animals need heat from the sun to keep warm. Plants need sunlight to make food. Animals cannot make their own food. They must eat plants or other animals in order to live. Without sunlight, there would be no living things on Earth.

How are these cows using the energy of the sun?

Temperature is measured according to a scale shown on a thermometer. By measuring the **degrees**- or marked measurement units- on a thermometer, you can compare temperatures in sunny and shady places. Place one thermometer in the shade. Place another thermometer in a sunny place. Which thermometer do you think will show the highest temperature after ten minutes? Try it!

How does the color of an object affect the amount of heat taken in by it? Place three thermometers in a sunny spot on the same surface. Cover the bulb of one thermometer with black paper. Cover the bulb of another thermometer with white paper. Leave the last thermometer in the sun with no paper on it. Which thermometer do you think will show the highest temperature after ten minutes? Why does this happen? (See suggested activity at end of text)

The light from the sun helps plants on Earth to grow. Look at the photo of plants grown with more or less sun. All the leaves come from the same plant. The leaves on the top branch grew in sunlight, but the leaves on the bottom branch grew without much light. What differences do you notice? Have you ever noticed that houseplants bend toward sunlit windows? What will happen to seeds if they are planted and watered but left in a dark room or under a box?

Example of plants grown in more or less light

Think of a question you could ask about plants and sunlight. For example, "Do plants grow toward the sunlight?"

Anything that gives off heat is a **heat source**. The sun is the main heat source for Earth. Have you noticed that you feel hotter in the sunlight than in the shade? It's fun to play in the warm sunshine in summer. But what happens when you stay in the sun too long? You get sunburned! A wide-brimmed hat and some sunscreen can help protect you from too much sun. Plants and animals need protection from the weather as well. They adapt to climates and seasons in order to survive.

How does the sun affect this ocean environment?

Have you ever melted an ice cube in your mouth? Many people think ice cubes give off cold. That is a **misconception**- a wrong idea. The ice cube melts because your body is a heat source. In winter, a zipped up coat traps your body heat and keeps you warm. If you leave your coat unzipped, your body heat will escape, and you won't be as warm. If you wrap a stuffed animal in a blanket, it will not warm up. The stuffed animal's body does not produce heat like your body does.

Think Like a Scientist

1. What different effects does the sun have on humans?
2. Do plants need the sun's heat or its light to live and grow?
3. Suppose you place two ice cubes in plastic bags. Now put one out on the counter. Wrap the other in a blanket or sweater. Describe what would most likely happen to the ice. (Try it!)

Online Interactive Activities

- http://tinyurl.com/UT3-1-5a Can you choose the right temperatures?
- http://tinyurl.com/UT3rd5-1b Interactive thermometer!
- http://tinyurl.com/UT3rd5-1c Build your own temperature scale.
- http://tinyurl.com/UT3rd5-1d How do you keep things warm?
- http://tinyurl.com/UT3rd5-1e Help save the world with science!
- http://tinyurl.com/UT3rd5-1f Friction and skateboarding
- http://tinyurl.com/UT3rd5-1g Can you create friction?
- http://tinyurl.com/UT3rd5-1h Four great games about forces and motion.

Science Language that Students Need to Know and Use

1. **temperature -** how warm or cold something is, usually measured in degrees
2. **heat source** – something that produces heat
3. **degrees** – marked measurement units on a thermometer
4. **misconception** – misunderstanding or wrong idea

Suggested Extension Activities:

Seed sprouts ready to cover with a box

Activity 1

You could investigate this question: "Do plants grow toward the light?" Make a list of materials you will need: two small pots filled with soil, a few seeds, and two shoeboxes, one with a hole in one side. Plan the steps for an investigation. For example, follow the steps below:

1) Plant and water the seeds in the pots.
2) When the plants begin to grow, place the pots in a sunny window.
3) Put the plain box over one pot.
4) Put the other plant under the box with the hole, keeping the hole toward the sunlight. Be sure the plant is on the far side from the hole.
5) Keep the seeds moist and observe them every few days.

6) Record your observations in a journal.
7) Draw a conclusion about plants and sunlight after the seeds have sprouted and grown.

Activity 2

How does the color of an object affect the amount of heat taken in by it?

Place three thermometers in a sunny place on the same surface. Cover the bulb of one thermometer with black paper. Cover the bulb of another thermometer with white paper. Leave the last thermometer in the sun with no paper on it. Place a fourth thermometer in the shade. Which thermometer do you think will show the highest temperature after ten minutes? Why is this happening?

Wait for ten minutes. Record your results in the table.

Thermometer	Temperature (degrees Fahrenheit)
In sunlight with black paper	
In sunlight with white paper	
In sunlight with no paper	
In shade	

What can you conclude about energy from the Sun after completing this activity?

Standard V. Objective 2: Grade Three
Text Structure: Description and Data Representation

Are There Sources of Heat and Light Other Than the Sun?

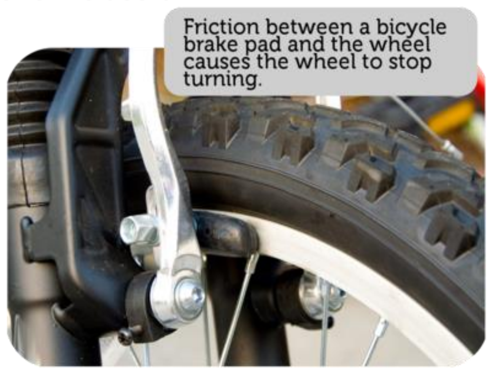
Another way to create heat is to use **mechanical energy.** Something that is mechanical moves or runs without a battery or electricity- energy. A non-electric pencil sharpener is an example of something that uses **mechanical energy**. An object's movement creates **mechanical heat**. Try rubbing your hands together. Do they get warm? Now, rub them together really fast. They should get warmer as you move faster. This is an example of mechanical heat. Mechanical heat is created by anything that moves or runs without a battery or electricity. When you hammer a nail into a piece of wood, the nail and the wood rub together, creating friction. This friction causes both the nail and the wood to heat up. Think of a question you could have about mechanical heat. Here is an example: "Will there be more heat if your hands are **lubricated**- slippery- when you rub them together?" Make a prediction about the answer based on what you know now. Put lotion on your hands and rub them together as fast as possible.

http://tinyurl.com/UT3rd5-2link

Was your prediction correct? Can you draw a conclusion about **lubricated** surfaces? Here is another investigation to test your conclusion: “Will rubbing sandpaper on wood produce heat?” Try rubbing sandpaper on a piece of wood as fast as you can. Did the wood heat up? Record the results. Based on what you now know, predict what will happen if you rub the sandpaper on wood that has been lubricated with oil. Was your prediction correct?

Rubbing your hands together creates friction. What happens as a result of this friction? Try it!

These photos show two ways that friction is useful:



These photos show two ways that friction can cause problems:

http://www.ck12.org/na/Friction-3/lesson/user%3Aam1vcnJvd0BjbGFzc2ljYWxhY2FkZW15LmNvbQ../Friction-and-Gravity/

Do you know what electricity is? Of course you do! You probably use electricity every day to turn on lights or watch TV. Anything with a battery or that plugs in is **electrical**- uses electricity. **Machines**- tools with fixed or moving parts for doing work- need energy to move. **Machines** can be mechanical or **electrical**. Mechanical and electrical machines produce heat and/or light. Mechanical machines can use burning fuel, human strength, flowing water or even horsepower to give them energy. The sun is a form of energy that can be used to power mechanical machines. Some people have solar panels on their roofs. Solar panels trap the sun's energy directly and can be used to light up houses and heat water.

Examples of mechanical and electrical heat sources

Electrical machines need electricity and usually plug into an electrical outlet or use batteries. Electrical energy can be a source of heat and light. A light bulb is an example of a simple electrical machine. It has no moving parts. There are many different types of light bulbs. Some light bulbs get hot and are a heat source. You can use a thermometer to measure the amount of heat given off by a light bulb.

Think Like a Scientist

1. What are some heat sources around us?
2. How do we measure temperature?
3. What is energy?
4. How can you reduce the amount of heat created by mechanical energy?
5. Electricity is all around us! Can you think of some objects that use electricity to produce heat or light, or both?

Online Interactive Activities

- http://tinyurl.com/UT3rd5-2link2 Energy
- http://tinyurl.com/UT3rd5-2link3 The Sun
- http://tinyurl.com/UT3rd5-2link4 Friction

Science Language that Students Need to Know and Use

1. **mechanical** - moves or runs without a battery or electricity
2. **electrical** - uses electricity
3. **lubricated** - a slippery surface
4. **machine** - tools with fixed or moving parts for doing work
5. **temperature** - how warm or cold degrees
6. **heat source** – something that produces heat
7. **degrees** – marked measurement units on a thermometer
8. **misconception** – misunderstanding or wrong idea

Books:

- *Flick a Switch: How electricity gets to your home* by B. Seuling, New York: Holiday House 2003
- *Electricity Everywhere by Jessica Quilty*, Pearson Education 2012
- *The Sun is My Favorite Star* by Frank Asch, Harcourt Brace 2000
- *Friction* (True Books) by Matt Mullin, Scholastic 2011

- *Energy Island: How one community harnessed the wind and changed their world* by Allan Drummond, Farrar, Straus and Giroux 2011

Activity:

For this investigation, you will need three thermometers, an incandescent light bulb, a compact fluorescent light bulb, and a LED light bulb. You will need a base for the light bulbs. Be careful not to touch the bulbs when they are turned on. You might want to wear goggles when conducting this test.

Place the first thermometer 1 inch away from the base, and place the next thermometer 6 inches away Put the last one 12 inches away. First, screw one of the light bulbs into the base and turn it on.   Next, wait 15 minutes. Then record the temperatures. Repeat the steps to test the other two bulbs in the same way. Record the temperatures in a chart. Some light bulbs are energy efficient. Energy efficient bulbs emit light, but loose very little heat, so they are not a heat source. Energy efficient bulbs are good for the environment because they last longer and use less energy to produce light. Have you learned which light bulbs are energy efficient?