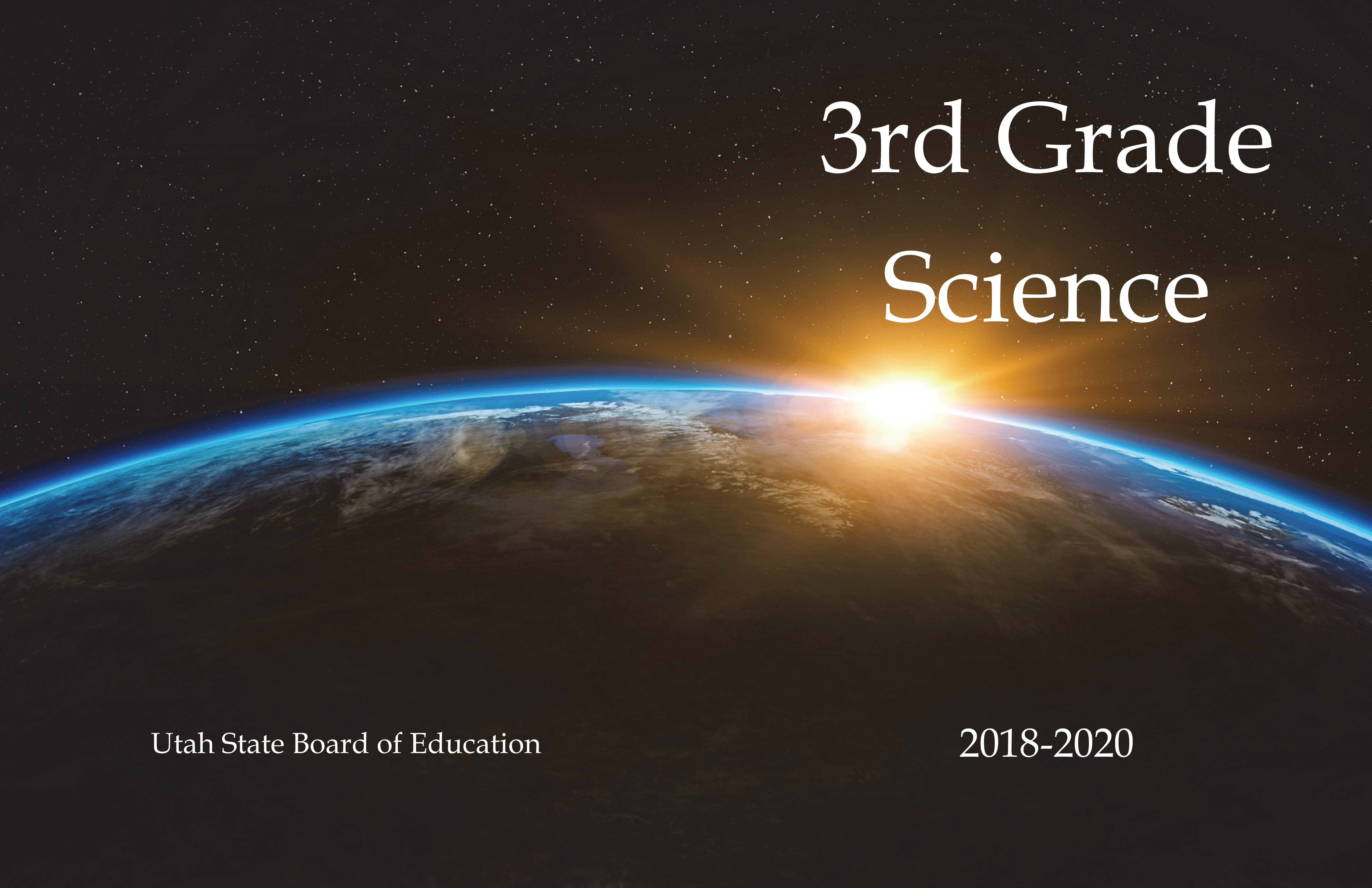
3rd Grade Science



Utah State Board of Education

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Utah Science Standards

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We especially wish to thank the amazing Utah science teachers whose collaborative efforts made the book possible. Thank you for your commitment to science education and Utah students!

Students as Scientists

Making Science

What does science look and feel like?

If you're reading this book, either as a student or a teacher, you're going to be digging into the "practice" of science. Probably, someone, somewhere, has made you think about this before, and so you've probably already had a chance to imagine the possibilities. Who do you picture doing science? What do they look like? What are they doing?

Often when we ask people to imagine this, they draw or describe people with lab coats, people with crazy hair, beakers and flasks of weird looking liquids that are bubbling and frothing. Maybe there's even an explosion. Let's be honest: Some scientists do look like this, or they look like other stereotypes: people readied with their pocket protectors and calculators, figuring out how to launch a rocket into orbit. Or maybe what comes to mind is a list of steps that you might have to check off for your science fair project to be judged; or, maybe a graph or data table with lots of numbers comes to mind.

So let's start over. When you imagine graphs and tables, lab coats and calculators, is that what you love? If this describes you, that's great. But if it doesn't, and that's probably true for many of us, then go ahead and dump that image of science. It's useless because it isn't you. Instead, picture yourself as a maker and doer of science. The fact is, we need scientists and citizens like you, whoever you are, because we need all of the ideas, perspectives, and creative thinkers. This includes you.

Scientists wander in the woods. They dig in the dirt and chip at rocks. They peer through microscopes. They read. They play with tubes and pipes in the aisles of a hardware store to see what kinds of sounds they can make with them. They daydream and imagine. They count and measure and predict. They stare at the rock faces in the mountains and imagine how those came to be. They dance. They draw and write and write and write some more.

Scientists — and this includes all of us who do, use, apply, or think about science — don't fit a certain stereotype. What really sets us apart as humans is not just that we know and do things, but that we wonder and make sense of our world. We do this in many ways, through painting, religion, music, culture, poetry, and, most especially, science. Science isn't just a method or a collection of things we know. It's a uniquely human practice of wondering about and creating explanations for the natural world around us. This ranges from the most fundamental building blocks of all matter to the widest expanse of space that contains it all. If you've ever wondered "When did time start?", or "What is the smallest thing?", or even just "What is color?", or so many other endless questions then you're already thinking with a scientific mind. Of course you are; you're human, after all.

But here is where we really have to be clear. Science isn't just questions and explanations. Science is about a sense of wondering and the sense-making itself. We have to wonder and then really dig into the details of our surroundings. We have to get our hands dirty. Here's a good example: two young scientists under the presence of the Courthouse Towers in Arches National Park. We can be sure that they spent some amount of time in awe of the giant sandstone walls, but here in this photo they're enthralled with the sand that's just been re-washed by recent rain. There's this giant formation of sandstone looming above these kids in the desert, and they're happily playing in the sand. This is ridiculous. Or is it?

How did that sand get there? Where did it come from? Did the sand come from the rock or does the rock come from sand? And how would you know? How do you tell this story?

Look. There's a puddle. How often is there a puddle in the desert? The sand is wet and fine; and it makes swirling, layered patterns on the solid stone. There are pits and pockets in the rock, like the one that these two scientists are sitting in, and the gritty sand and the cold water accumulate there. And then you might start to wonder: Does the sand fill in the hole to form more rock, or is the hole worn away because it became sand? And then you might wonder more about the giant formation in the background: It has the same colors as the sand, so has this been built up or is it being worn down? And if it's being built up by sand, how does it all get put together; and if it's being worn away then why does it make the patterns that we see in the rock? Why? How long? What next?

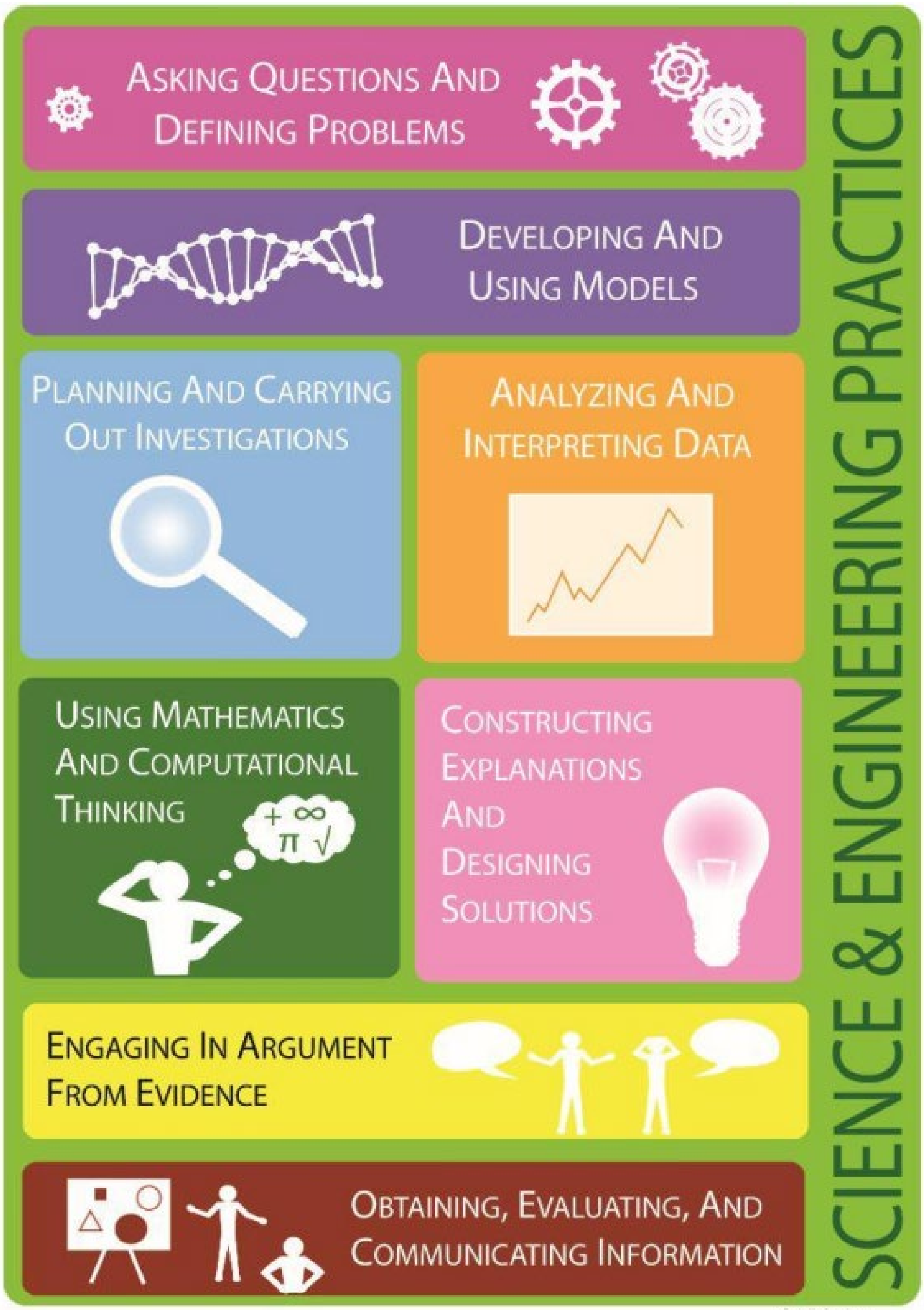
Just as there is science to be found in a puddle or a pit or a simple rock formation, there's science in a soap bubble, in a worm, in the spin of a dancer and in the structure of a bridge. But this thing we call "science" is only there if you're paying attention, asking questions, and imagining possibilities. You have to make the science by being the person who gathers information and evidence, who organizes and reasons with this, and who communicates it to others. Most of all, you get to wonder. Throughout all of the rest of this book and all of the rest of the science that you will ever do, wonder should be at the heart of it all. Whether you're a student or a teacher, this wonder is what will bring the sense-making of science to life and make it your own.

Adam Johnston

Weber State University

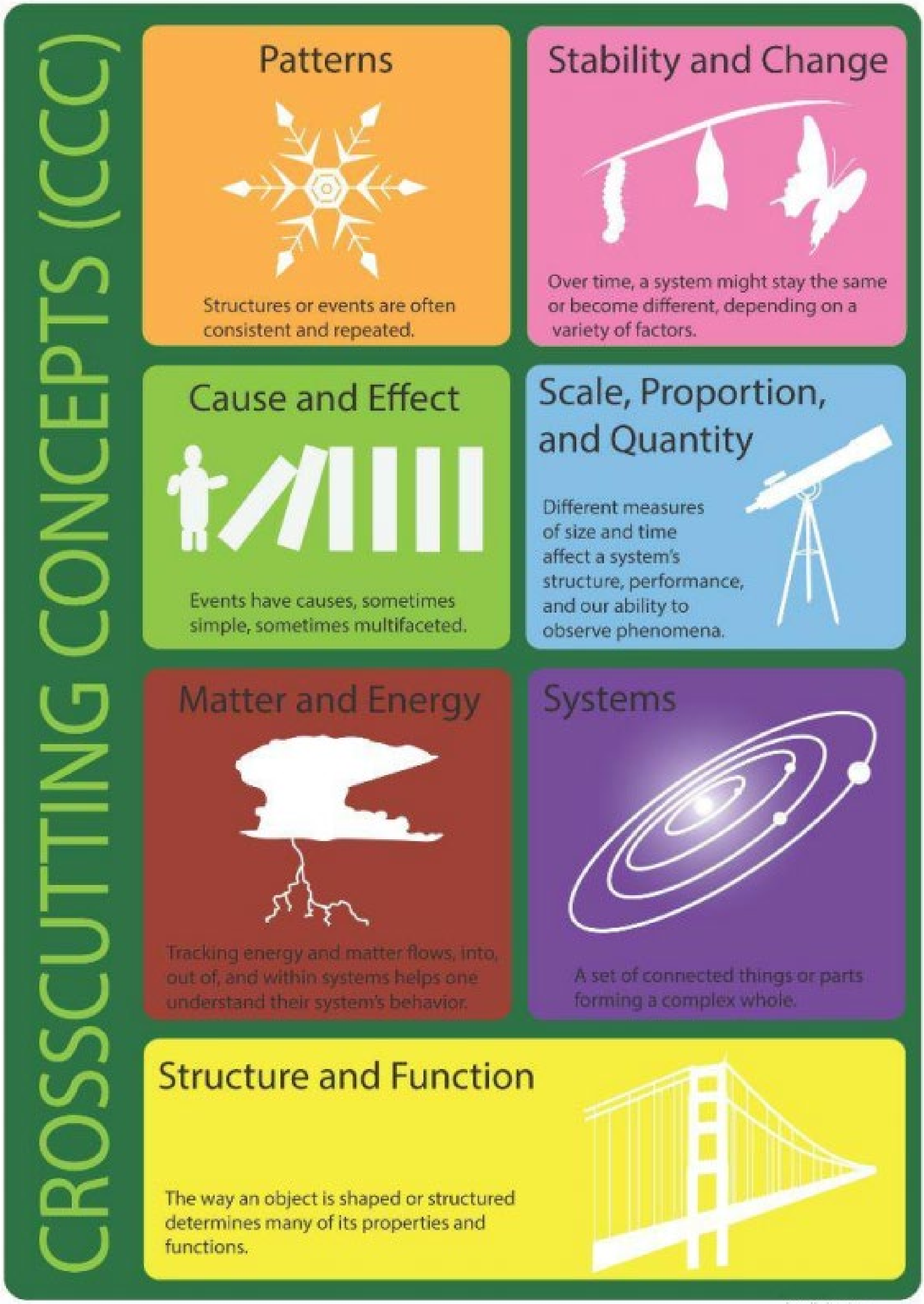
Science and Engineering Practices

Science and Engineering Practices are what scientists do to investigate and explore natural phenomena.



Cross Cutting Concepts

Crosscutting Concepts are the tools that scientists use to make sense of natural phenomena.



A Note to Teachers

This Open Educational Resource (OER) textbook has been written specifically for students as a reputable source for them to obtain information aligned to the 3rd Grade Science Standards. The hope is that as teachers use this resource with their students, they keep a record of their suggestions on how to improve the book. Every year, the book will be revised using teacher feedback and with new objectives to improve the book.

If there is feedback you would like to provide to support future writing teams please use the following online survey: http://go.uen.org/b62

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CHAPTER 1

Standard 1: Earth and Moon

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.

1.1 Earth and Moon

Imagine what it would be like without the Sun?

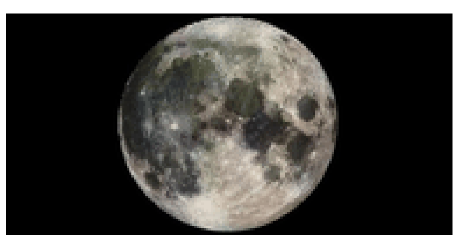
The Earth would be a cold, dark place. Life could not survive on the Earth without the Sun and that includes us.

The Sun is the largest object in our solar system.

The Sun is shaped like a **sphere**. The Sun also makes light. That's right. Light-making is the Sun's superpower. That's intense!

The Sun's light is so intense that if you look directly at it, it will damage your eyes. Don't do it! The next picture shows how bright the sun is.

Quick! We know the Sun is the brightest object in our sky, what is the second brightest object in our sky? If you guessed the **Moon**, you're right.

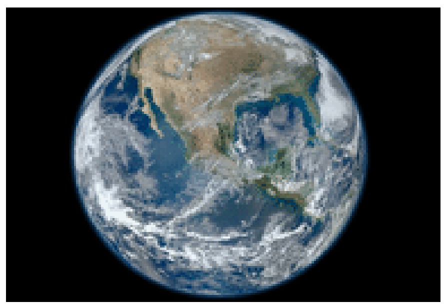


Moon reflecting sunlight

When viewed from Earth, the **Moon** looks like it is glowing. The **Moon** doesn't make its own light like the Sun does. See how much duller the last picture of the moon is compared to the sun? So, what makes it shine? As the Sun's light shines on the **Moon,** light reflects off its surface. We see the sunlight reflecting off the **Moon**. It makes the **Moon** appear to be glowing.

Earth does the same thing. If you were standing on the **Moon** looking back at Earth, you would see the Sun's light reflecting off of Earth. Sunlight **reflects** off all the planets and **moons** in our solar system. That's how we know they are there.

Take a look at the next picture of the Earth. How does it compare to the other pictures? You can see that the Earth's appearance is different.



Earth from Space

When we look at Earth from space we can see many things. You can see the land and the water. You also see the clouds that surround the Earth. The clouds are part of Earth's atmosphere.

Look at the photo of the **Moon**. From space, you can see hundreds of bowl shaped areas, called craters. Craters are made from space rocks hitting into the **Moon's** surface. You can also see mountains and dark flat areas. 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. This next picture compares the sizes of the moon and the earth.

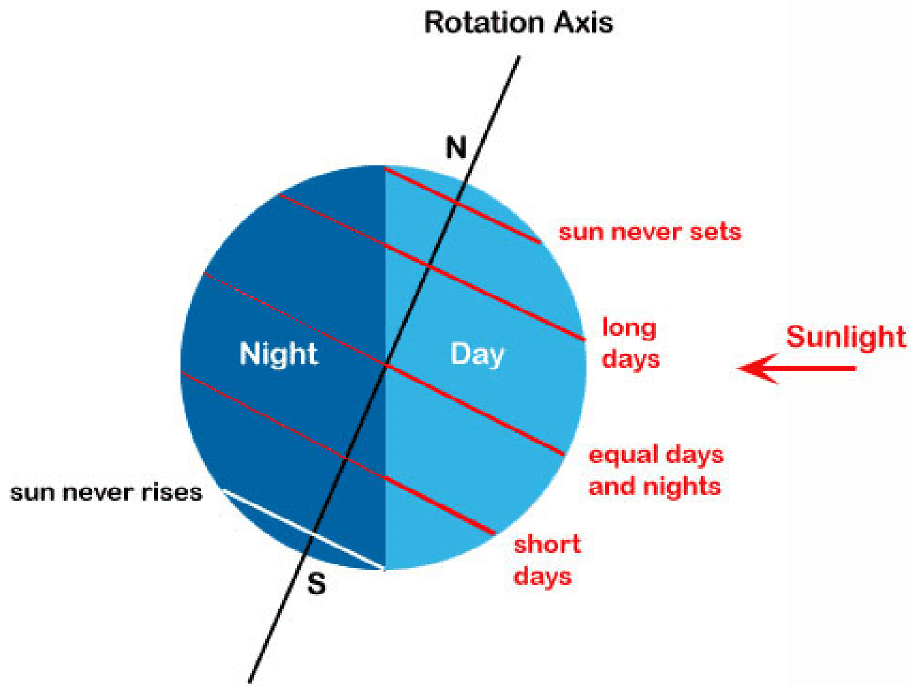
The **Moon** is about 1/8 the diameter of the Earth.

So here's a question. Have you ever wondered why the Sun seems to be moving in our sky? It rises each morning—thank goodness—and sets each evening. It appears to travels across our sky each day.

The Sun actually isn't moving across our sky each day. It is the Earth's 24 hour **rotation** that makes the Sun look like it is moving from east to west in our sky. Since Earth is a **sphere**, sunlight can only shine on half of Earth at one time. When the Earth rotates, different parts of Earth get light. This is kind of like a spinning top. The stem of the spinning top is like Earth's **axis**. Earth doesn't stay still, but rotates or spins around on an **axis**.

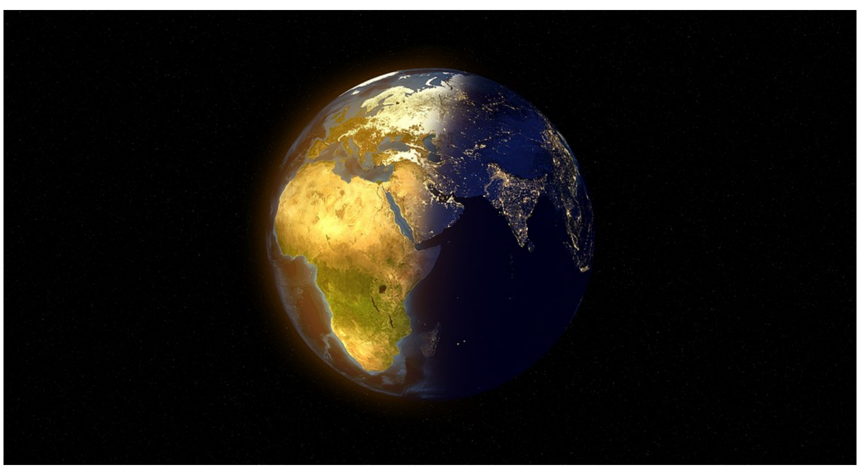
What observations can you make about the next picture of the spinning top? How does this help you understand Earth?

This **rotation** 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 our sky. Finally, the **rotation** of Earth takes the sun out of our view in the evening. We call this a sunset. As Earth continues to rotate on its **axis**, the Sun will seem to come up again.



Earth takes 24 hours or one day to make a full **rotation**.

The **rotation** of Earth brings the sun in and out of view. The next picture shows how the Sun can change the light on Earth.



Day and night of Earth

When the Sun is out of view and dark, what do you see in our sky? Yes! Stars and planets appear in our night sky.

If you watch the planets and stars carefully, most of them seem to be moving across our sky. Some go in and out of view, appearing to set and rise like the Sun.

This happens because Earth **rotates**. Just as the Sun appears to move across our sky, the stars and planets also appear to move across our sky.

As Earth rotates it also takes a long journey around the Sun. This yearly journey is called a **revolution**. This **revolution** takes about 365 days, or one year. On its journey around the Sun, Earth follows an **orbit**. An **orbit** is 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 **mode**l.

Try This: Rotation

- 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 rotate the globe.

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. Other parts are dark. This model shows how we get night and day from the rotation of Earth.

What can you see when your location is in sunlight?

When your location is in sunlight, you can see the Sun, clouds, and other objects in the daytime sky.

Now, follow your rotation into sunset and night time. Remember that Earth rotates on its axis once every 24 hours to produce the night and day cycle. The next picture can help us see light and dark during the rotation.

View of Earth from the **Moon**

Our **model** can also show Earth's **revolution** around the sun.

Try This: Revolution

- With the globe in hand, walk around the lamp in a circle.
- 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 is one year. If you were to continue to walk around the lamp in the same path, this would represent Earth's **orbit**.

Try This: Nighttime Sky

- Attach a star on the wall behind the globe about twenty feet away.
- Now, turn the globe on its **axis**.

If we were on the globe, we would see the star at night. As the globe spins, the star seems to move across the night sky. Stars can be seen all over the sky. However, they can only be seen at night because the Sun is too bright for the stars to be viewed during the day.

Let's find out more about the **Moon**. You may 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. See how this picture shows the moon? Is it as bright as the moon at night? Why?

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 has made a full **revolution**. The **revolution** of the **moon** orbiting Earth takes between twenty-eight and 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.

Try This: Moon Revolution

- Put the lamp in the middle of the room.
- Hold the globe as you did before.
- Another student slowly moves a small ball around the globe. This ball represents the **Moon**.

When the ball returns to the same place it began, this is a full **orbit** of the **Moon** around Earth. Watch to see where the light falls on **Moon** and Earth. What would this look like from Earth?

Try This: Try this simulation to see the orbital paths of Earth and the Moon.

http://go.uen.org/b0g

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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** appear to shine?

3. Explain what causes night and day on Earth.

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

5. Give details about the **Moon'**s **revolution**.

6. Why does it seem that the Sun changes position in the sky?

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

Science Language Students Need to Know and Use

- **Appearance:** the way something looks.
- **Axis**: an imaginary line that goes through the center of a planet.
- **Model**: a representation of something.
- **Moon**: a natural, **rocky** object that goes around a planet.
- **Orbit**: the path an object in space follows as it revolves around another object.
- **Reflect**: to bend or throw back light waves.

- **Revolution**: one **orbit** of an object in space around another object in space.
- **Rotation**: the spinning of an object (planet) around its own **axis**.
- **Sphere**: a round, solid object

Supporting Vocabulary for ELL

- Object: a thing that can be seen or touched.
- Shallow: not very deep.
- Produce: to make or cause something.
- Cycle: a set of events or steps that are repeated in the same order.
- Represent: to serve as an example or **model** of something.

CHAPTER 2

Standard 2: What is Alive?

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, flower bed) 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.

2.1 What is Alive?

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

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

We **observe** all sorts of exciting things on the playground. Some of these things are **living**, and others are **nonliving**. Sometimes it is easy to tell if something is **living** or **nonliving**. A dog moves and is a **living** thing. A flower grows and it is also a **living** thing. Both flowers and dogs can reproduce. **Living**, growing and reproducing are characteristics of **living** things.

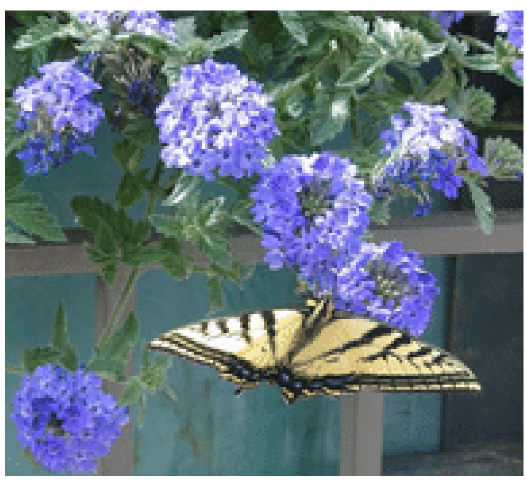
Nonliving things do not have all these characteristics. A rock does not move on its own. It does not grow and it does not reproduce so it is **nonliving**.

What about plants? Even though plants don't play catch, they do move. Plants slowly move above the soil toward the sun. The roots of plants move under the soil. Plants also grow and reproduce, so they are **living** things.

Sometimes it's hard to tell if something is **living**. Fire seems to grow and move. It isn't a **living** thing, though. It doesn't reproduce. Another word for **living** thing is **organism**.

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. They were once alive, so we call them "once **living**." The seed in your apple may not look like a **living** thing, but it can grow into a tree. It has the potential for life. If we plant the seed in soil and give it plenty of water, it could grow into an apple tree.

What is **living** in the next picture? What is **nonliving**?



Living things move, grow, and reproduce.

How Do Organisms Use Their Environment?

Look at this picture. What organisms do you see? How are these organisms interacting with their surroundings?

Environments are places where plants and animals live. The plants and animals **interact** with each other. That means they act upon each other. For example, a bird will fly away from a cat. A fish eats bugs on the surface of the water. Worms like to hide under rocks. Bees take the pollen from plants and make honey. What do each of these have in common? The plants and animals share the same space. They are aware of what is around them. They respond to the environment so they can survive.

Every environment has both **living** and **nonliving** things. The **living** things include the plants and animals you can see. Some may be hidden. For example, we can see the large trees in a forest, but might not find the tiny mushrooms that grow under the fallen leaves. These are both examples of **living** things in a forest. Large animals like elk, red-tailed hawks, and squirrels can be easier to find. You have to look closely to find earthworms, insects, and tiny hummingbirds.

The **nonliving** parts of an **environment** play are important. Soil is **nonliving**. It is a place where plants grow and animals 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 **environment**? Without these two **nonliving** things, nothing on Earth would be able to live. **Nonliving** and **living** things **interact** in an **environment**. What interactions do you see in the next pictures?

Living and **nonliving** things interact in an **environment**.

You might be curious about how **living** and **nonliving** things interact. What questions do you have? You could think of an investigation that might answer a question. For example, what would happen if you change something in an **environment**? You might decide to change the amount of light a plant gets. Use small plants to investigate. Set one plant in a sunny window. Put another in a dark corner.

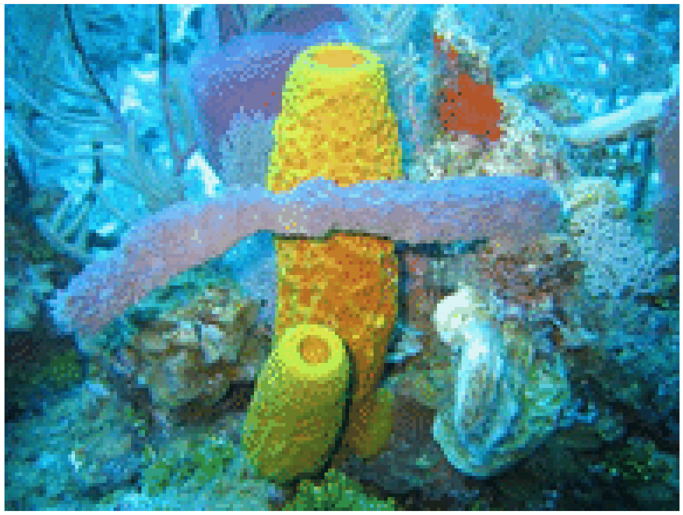
Make some predictions and collect your data. What did you find out? Can you think of other questions to investigate? Scientists call these questions “testable questions”. A good testable question can become an investigation or experiment.

Environments can be large or small. Large environments, such as forests, can be difficult to study because they contain many organisms.

Scientists use a **small-scale environment** when they want to control what is happening. If they want to study a forest, they might use a **terrarium**. A **terrarium** is a container with soil where land plants and animals are kept. It is easier to control things in a **terrarium** than in a whole forest. Terrariums can help scientists understand what is happening in a large-scale area. The next two pictures show a terrarium and a forest. How are they alike? How are they different?

Scientists can study **living** and **nonliving** things in a **large-scale environment** such as this wetland.

An **aquarium** is a **small-scale environment**. It is small but shows us how a larger system works. Aquariums help us learn about ponds and oceans. Look at the picture below. Do you think this a salt water (ocean) or pond aquarium? Why?



Small-scale environments are different from l**arge-scale** ones. First, they don't include as many plants or animals. They may also not include as many **nonliving** things. They show us how plants, animals and **nonliving** things work together. We can use this information to help large-scale environments like forests and oceans.

Aquariums are used to study small-scale environments. We can see how **living** things interact with each other. They also interact with the **nonliving** things.

Organisms, including people, **interact** with the **nonliving** parts of their **environment**. An **environment** includes light, moisture, **temperature**, and air. The **nonliving** parts help us feel comfortable. Have you ever seen a polar bear in a desert? No! It's too hot for the bear! If a plant or animal is not adapted to its **environment** it will not survive.

Sometimes, an e**nvironment** changes. It may change so much that some organisms can't live there anymore. What can an **organism** do if the **environment** changes? Some animals move to a new

environment. Others may die. Plants cannot move easily move from place to place. Plants move slowly over time by spreading their seeds. 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 protect ourselves and the **environment** we live in, too.

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. How could you determine how much light plant needs?

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

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

6. Compare and contrast **living** and **nonliving** things.

7. How do you think scientists sort **living** things?

8. Are there other **living** things besides plants and animals?

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

Science Language Students Need to Know and Use

- **Living** - able to grow, reproduce, and move.
- **Nonliving** - not able to grow, reproduce, or move.
- **Organism** - a living thing.
- **Aquarium** - a container filled with water where plants and animals are kept.
- **Environment** - the living and nonliving things in an area.
- **Interaction** - things acting upon one another.
- **Observe** - see or sense with careful study.
- **Small-scale** - small in size.
- **Temperature** - how warm something is, usually measured in degrees.
- **Terrarium** - a container with soil where land plants and animals are kept.
- **Large-scale** - large in size.

Supporting Vocabulary for ELL

- Reproduce – to produce new individuals of the same kind.
- Container – an object that can hold something else.
- Adapt – to change in a way that allows an **organism** to live in a different place.
- Desert – an area on Earth that is very dry, usually getting less than 10 inches of water per year.
- Forest – an area on Earth that supports many trees and other plants.
- Wetland – an area on Earth where water loving plants and animals can live such as a pond or the banks of a river.

CHAPTER 3

Standard 3: What is a Force?

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).

3.1 What is a Force?

What is the difference between a Push and a Pull?

A **force** makes an object move. In fact, an object won't move at all unless a **force** is making it move. 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. It will stay where it is unless you apply a push or a pull. If you use your hands to 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.

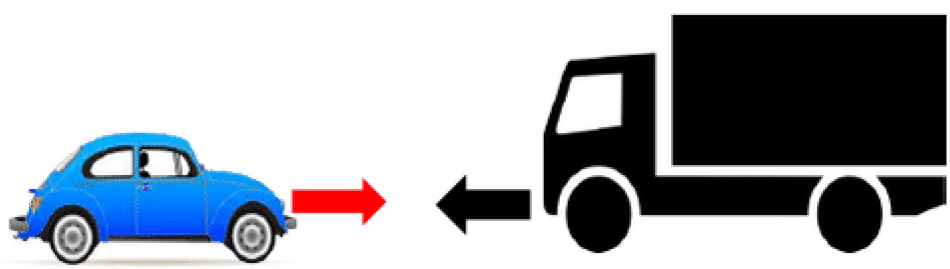
A pull is the opposite **force** of a push. A pull is a **force** that comes toward you. The two dogs are pulling the rope in opposite directions. Which dog do you think will win? It depends on which dog pulls on the rope with the greatest force.

Try It: Force and Motion Simulation http://go.uen.org/aYK

You use push and pull forces a lot. During recess, watch as people play. Which activities require a push or pull? How often do they push or pull? They may be batting, kicking, or throwing a ball. The amount of force they apply to the ball changes where the ball will travel. It also can change the direction. A direction is a path on which something moves. You will be surprised how often you and your friends use these forces. Even turning a jump rope requires a force.

Forces and Mass

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**. **Mass** is the amount of material in an object. Objects with more **mass** require more **force** to move, to turn, and to stop. We measure an object's **mass** by weighing it.



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.

Try It: Unequal Mass

- Roll the basketball and the ping pong ball toward each other. Be sure they hit head-on.
- What happens when they meet?

The ping pong ball is pushed back or away by the **mass** of the larger basketball. Some other collisions to try:

- Two balls with the same **mass**.
- A large toy car hits the side of a small toy car.
- Two toy cars with the same **mass**.
- Can you think of others?

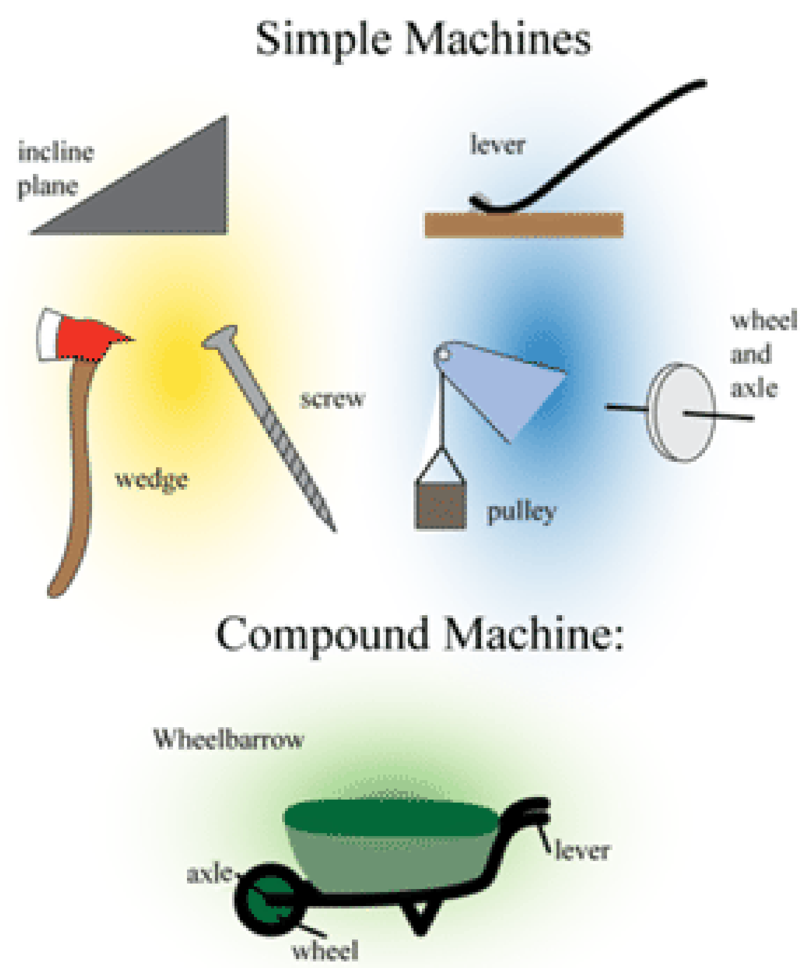
Start, stop, change direction

Not only do objects need **force** applied to them to move, they need **force** applied to stop moving or to change its **motion**. **Motion** is the act or process of being moved. 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 and friction slow the ball down. Soon the ball will 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**. Your kick or hit may also change the speed of the ball. It could go faster after a hard hit, or slower after a gentle kick.

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 of the rock.

Another way to move the rock from the garden is to use a **simple machine**. A simple machine changes the strength and direction of a force. Six **simple machines** are shown in the picture below. Each one helps us do work. Let's look at each **simple machine** in the next picture and see how it helps.

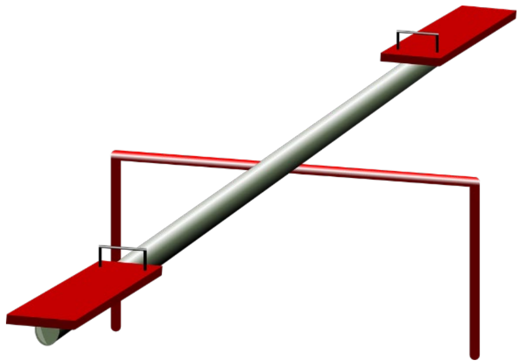


A ramp helps us move heavy things.

An inclined plane, or ramp, can be used to move heavy objects. You might be able to push the rock up a ramp, but there will be a tradeoff. Can you think what it might be? You will have to move the rock farther if you use a ramp.

This hammer is acting as a lever.

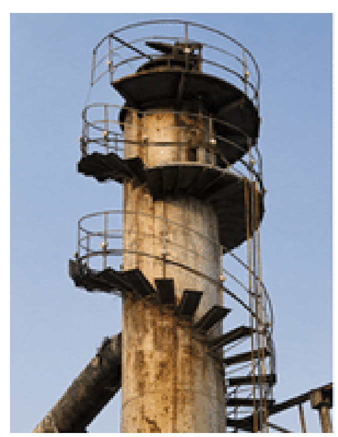
A lever is another **simple machine**. You could choose to use a lever, which looks like a teeter-totter. The picture below shows a teeter-totter. Imagine placing the teeter-totter under the rock. Push down on the opposite side. The rock will move more easily and will rise a short **distance**. A **distance** is how far an object travels. You must push down on the other side a long **distance**.



A teeter totter is a lever.

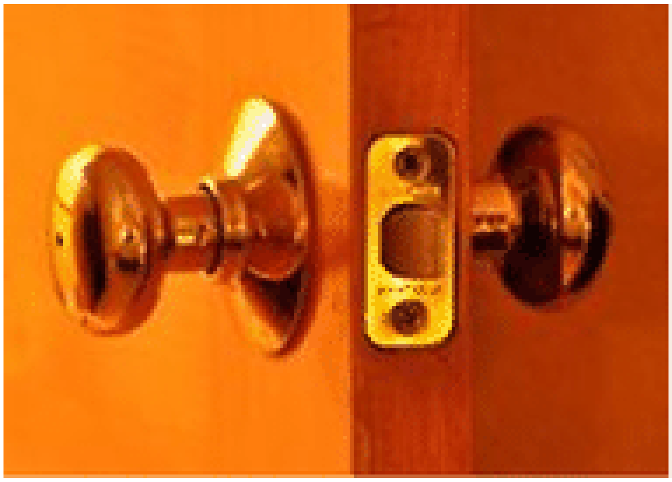
A wedge is another **simple machine.** An axe is an example of a wedge. Think how hard it would be to chop wood without an axe.

An axe is a wedge.



This **simple machine** certainly helps us do work! This tower's spiral staircase is a screw.

A screw is an inclined plane that has been wrapped around a center point. Screws are often used to hold things together. The cap on your water bottle uses a screw to stay in place. A light bulb has screw threads to hold it in a lamp.



Wheels also are simple **machines**. A wheel has a center point called an axle. The wheel moves around the axle. Wheels are important **machines**. You see wheels everywhere, from the tires on your car to the doorknob you use to get into your house.

A doorknob is a wheel and axle.

Pulleys are wheels with ropes attached. They change the **direction** of a **force**. If you thread a rope through a pulley, you can pull down instead of up. That can be useful for things like raising a flag. When we connect many pulleys together we can lift heavy things. The tradeoff is we have a lot more rope to pull. This crane uses a pulley to lift heavy objects.

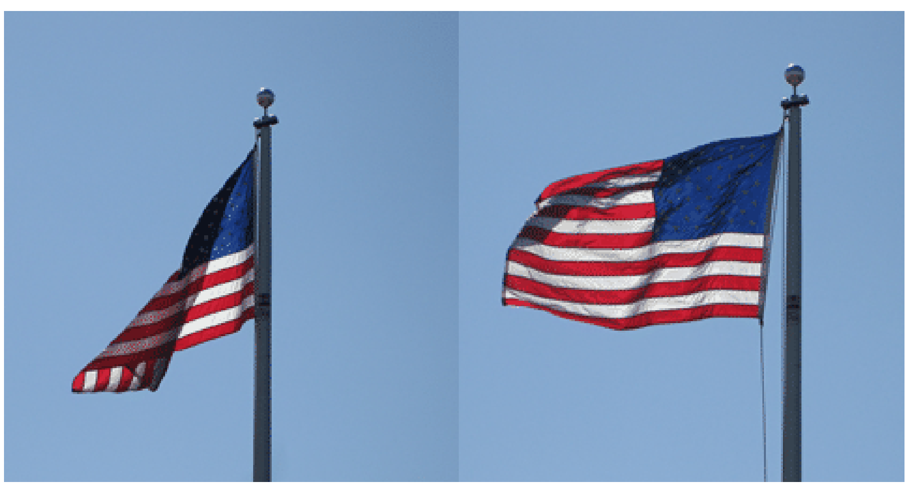
Simple **machines** can certainly help us with work, but they can't make the work go away. Remember, there's always a tradeoff. Simple **machines** trade **distance** or time for **force**.

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? Water can move objects if it is flowing. 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 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. Why does this happen? Slow-moving water has little energy. Fast moving water has much more energy. The amount of energy is important. Heavy objects need more energy to move them.

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. There is little energy so the flag doesn't move much. But when the wind blows hard, the flag will fly straight out from the mast. There is more energy so the flag moves a lot. The air particles push against the flag, making it move.



Calm days mean little energy. Windy days mean more energy.

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?

Science Language Students Need to Know and Use

- **Direction** - a path that an object travels.
- **Force** - a push or pull.
- **Motion** - a change of position.
- **Gravity** - an invisible force that pulls objects toward each other.
- **Simple machine** - a tool with no moving parts used to make work easier such as a lever, inclined plane, or pulley.
- **Speed** - how fast or slow an object is moving.
- **Weight** - a measure of the force of gravity on an object.
- **Distance** - how far an object travels

CHAPTER 4

Standard 4: Gravity

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.

4.1 Gravity

Why is jumping on a tramp so much fun? Its springy top helps you jump higher. But even on a trampoline, you can't keep going higher. **Gravity** always pulls you back down. **Gravity** - It's the force that pulls things to Earth. You can't see it, but **gravity** is a very strong force.

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. All the material that makes up your body is your **mass**. 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 your **mass** down onto the scale which shows your **weight**. Without **gravity**, you would not have **weight** but you would still have **mass**.

Did you know that you would weigh less on the Moon than you do on Earth? There is less **gravity** on the Moon, so your scale would show less **weight**. But your **mass** wouldn't change. You would still have the same amount of material in your body.

Mass and Work

When you lift something you are doing work. Lifting a heavy object may be hard. Lifting overcomes the pull of **gravity**. You need a stronger force to lift a heavier object. Look around your classroom. What do you think is the heaviest object? 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.

Try It: Overcoming Gravity

- Choose a heavy object and a light object in your classroom.
- Lift the light object with one hand. Hold it in front of you. How much work does it take to keep that object where it is?
- Now try lifting the heavy object in one hand. Hold it in front of you. How much more work does it take to hold the heavy object where it is?

Which of these beanbags requires the most work to hold?

For many years, people thought that heavier objects would fall faster than lighter ones. A scientist named Galileo asked, “Do all objects fall at the same rate?” Galileo knew that it was important to test his ideas. He thought of an experiment to find the answer to his question. He dropped two different sized cannonballs off the Tower of Pisa. People were surprised to see they both reached the ground at the same time. They thought the heavier cannonball would hit the ground first. Galileo did other experiments to test his ideas. You can try them yourself.

Try This: Pull of Gravity

- 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.
- Make a prediction about how they will land.
- 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.

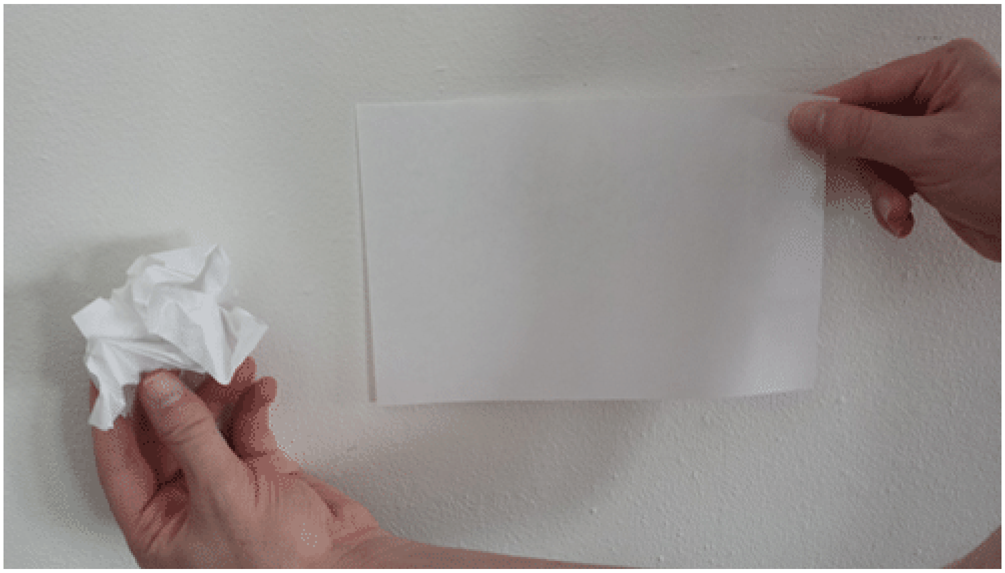
- Watch to see how they hit the ground at the same time.
- Now pick two objects that are not the same **mass** like a paperclip and a rock.
- Make a prediction about how they will land. Will the paperclip land first? The rock? Or will they land at the same time?
- Keep trying pairs of objects.

You can record your results in a data chart. When you finish, think about your results. Did anything surprise you? Can you make a statement about how **gravity** acts on objects?

Some other things to try with **gravity**:

- **Gravity** pulls things downhill. Use a ramp to test how things are pulled downhill.
- **Gravity** works on people as well as objects. Investigate how far off the ground you can jump. Can other people jump higher? Why do you think that happens?

How is gravity helping these skydivers?



Try This: Air Resistance

- 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. Didn't we just learn that objects fall at the same speed? Well, the flat paper had another force acting on it. The flat paper probably sailed around for a moment before touching the ground. It acted like a paper airplane. This is because air is pushing against the surface of all objects. 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 particles rub on the surface of the paper. This rubbing is an example of friction. The air slows the flat paper down more because it has more surface area.

Extend your thinking

What other objects may also act this way? You might want to try a feather or a balloon. Does an inflated balloon fall slower than one that is empty? Why?

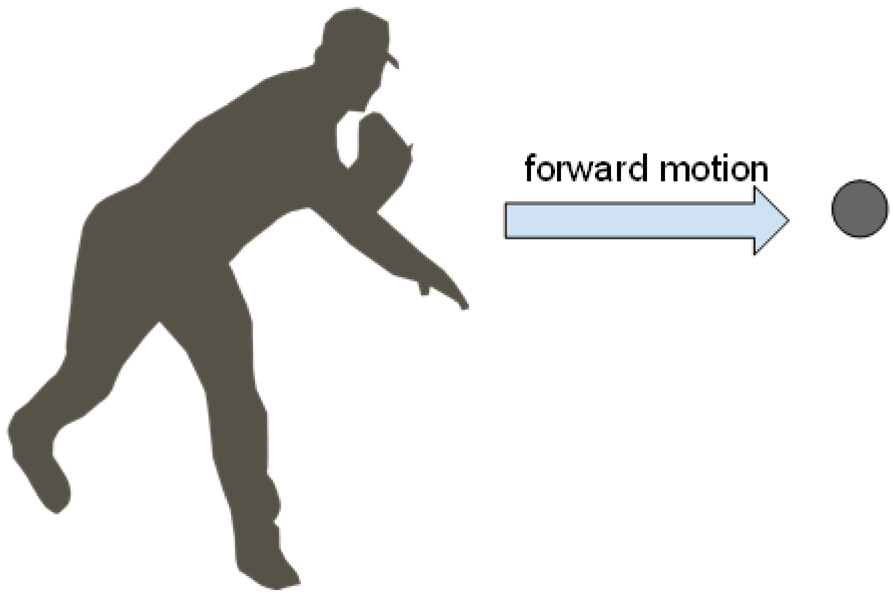
Working against gravity

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

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.** In order for planes, birds, and rockets to stay in the air a force must act on them.

For a plane, the force is the motor that pushes or pulls it through the air. What force do birds use? That's right. They move their wings to push them through the air.

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 moving forward because of the forward force of your throw, it also falls downward due to the force of **gravity**. The movement of the ball when it's thrown is called forward motion. **Motion** is when an object moves from one place to another. The ball's **distance** - how far apart objects are located, is increased by the force of the throw.



Try This: Pulling Force of Gravity

- Roll a ball across the floor. What force are you using? That's right, you are pushing the ball using your muscles. Pushing with your muscles causes the ball to move forward.
- What force is moving the ball this time? The force of **gravity** pulls the ball down the ramp.

Gravity works the same whether you drop a ball, throw a ball, or roll it down a ramp. The **mass** of the object won't affect how fast it drops even if you throw it very hard. It will hit the ground at about the same time as a ball that is dropped from the same height. But you must throw it straight for this to work. If you roll a large object and a small object down a ramp, they will hit the ground at the same time. Is there any way to **speed** up or slow down things on a ramp?

Speed is the rate at which something is able to move. Try changing the angle of the ramp to the ground.

Try It: Ramp Angle

- Place a ball or toy car on a ramp. Let it go.
- Raise the height of the ramp. Make a prediction and try it again. Did anything change?
- You can make a graph to show how the height of the ramp affects the **speed** - how fast an object moves-of the ball as it rolls.
- Don't forget to check how far the object rolls. Does the **distance** change if you raise or lower the ramp?

Think like a Scientist

1. How does **gravity** work when you drop objects?
2. What is **mass**?
3. What is **weight**?
4. How are they the same?
5. How are they different?
6. Does **gravity** push or pull objects? Give an example.
7. What happens to objects pulled by **gravity** down a ramp?
8. What must you change to affect the speed and **distance** of the object?
9. Why is **gravity** important?
10. Is the force of **gravity** the same for heavy and light objects? Explain.

Science Language Students Need to Know and Use

- **Force** - a push or pull.
- **Gravity** - a force that pulls objects down toward the center of the earth.
- **Weight** - the amount of gravity pulling on a mass.
- **Mass** - the amount of matter something is made of.
- **Distance** - how far apart objects are.
- **Motion** - when an object moves from one place to another.
- **Speed** - how fast an object moves.
- **Direction** - which way an object moves.
- **Simple machine** - A tool that makes work easier. It does this by changing how forces are applied to an object.

Supporting Vocabulary for ELL

- Overcome - be more powerful than something else.
- Demonstration - the process of showing something.
- Prediction - best guess based on evidence; a hypothesis.
- Ramp - a tilted surface.

CHAPTER 5

Standard 5: The Sun

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.
d) **Objective 3** Demonstrate that heat may be produced when objects are rubbed against one another.
e) Identify several examples of how rubbing one object against another produces heat.
f) 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).

5.1 Why Do We Need the Sun?

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. The Sun provides Earth with light and heat. 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 and light for organisms **living** on Earth. Without the Sun, **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?

The thermometer is a tool for measuring how much heat something has. **Temperature** is measured in degrees. The degrees are marked on the thermometer in units. If the **temperature** is cooler, it has a lower number of degrees. If the **temperature** is warmer, it has higher number of degrees.

You use a thermometer to take your **temperature** when you are sick.

We get most of our heat from the Sun. The Sun's heat warms everything on Earth. But not all objects warm up at the same rate. Many things can affect how much of the Sun's heat an object receives. You already know that objects in the shade receive less heat. That's why the shade feels cool on a hot, sunny day. The material an object is made of can affect how much heat it gains. Next time you are outside, check the **temperature** of different materials. You'll probably find that the street feels warmer than the grass. A car's hood may feel warmer than tree bark. How does the color of an object affect the amount of heat taken in by it?

Try It: Absorbing Heat

- Use four thermometers.
- Place three thermometers in a sunny place on the same surface.
- Cover the bulb of thermometer one with black paper.
- Cover the bulb of thermometer two with white paper.

- Do not cover the bulb of thermometer three.
- Place thermometer four in the shade.
- Make a prediction: which thermometer do you think will show the highest **temperature** after ten minutes?
- Wait for ten minutes. Record your results in the table.

Area	Temperature (degrees F)
In sunlight with black paper	
In sunlight with white paper	
In sunlight with no paper	
In shade	

What did your data show?

Do you think the color of an object makes a difference in the amount of heat it takes in?

What is your evidence?

Plants and Sunlight

The light from the Sun helps plants on Earth grow. Look at the photo of plants below. The leaves on the top branch grew in sunlight. The leaves on the bottom branch grew without much sunlight. What differences do you notice?

Both the Sun’s heat and its light are important to plants. Plants use sunlight to make food. If they don’t get enough light, they won’t be healthy. Animals depend on the Sun’s heat and light, too. Without heat and light animals wouldn’t have food or warmth.

Have you ever noticed that house plants bend toward sun lit windows? What will happen to seeds if they are planted and watered but left in a dark room or under a box?

Try It: Growing Plants

- Plant seeds in small pots and water them.
- Choose some locations around your classroom for each plant. Some locations should receive lots of light. Other locations should receive less light or no light.
- Make a prediction about what you think will happen.
- Check the plants often and water them as needed.
- Continue the experiment for a few days or weeks.

What happened?

Did it match your prediction?

You can try again with different plants or different locations to learn more. The Sun is the main **heat source** for Earth. We need the Sun to survive. But we need protection from too much Sun. If we stand in the Sun for too long we may get sunburned or overheated. Plants and animals need protection from the weather as well. They adapt to climates and seasons in order to survive. Some plants and animals need more heat and light. Others can survive with less heat and light. Polar bears can live where it is very cold. They have adapted to their **environment**. Palm trees grow well in very hot places. They so not grow very well in colder environments. Every plant and animal has different needs for heat and light. But, organisms need the Sun to survive.

How does the Sun affect this ocean environment?

Misconceptions

Have you ever melted an ice cube in your hand? Many people think ice cubes give off cold. That is a **misconception**. A **misconception** is a wrong idea. The ice cube melts because your body is a **heat source**. Heat is going from your hand to the ice cube until they are the same **temperature**. It is a **misconception** that cold moves into your hand. Instead, think of heat leaving your hand.

In winter, a zipped up coat traps your body heat and keeps you warm. The **misconception** is that the heat comes from the coat. If you leave your coat unzipped, your body heat will escape, and you won't be as warm. The coat has no heat of its own. Instead, it traps your body's heat inside the coat. This happens with blankets on your bed, too. Even the insulation in the roof of a school helps trap heat inside. 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.

Try It: Insulation

- Use a thermometer to find the **temperature** of a blanket.
- Wrap a stuffed animal in the blanket.
- Put the thermometer inside the blanket, too.
- Make a prediction about what the **temperature** will be in 5 minutes.
- Take the **temperature** of another blanket and wrap it around yourself.
- Place a thermometer inside your blanket as well. Check both thermometers in 5 minutes.

What happened?

Did it match your prediction?

Our bodies are able to create heat because we eat food and use that food as fuel. It keeps us warm and helps us move and grow. A stuffed animal doesn't eat food and doesn't make heat of its own. This is why your coat won't make you warm, it only keeps you warm. What would happen if you wrapped an ice cube in your coat?

Can you design an experiment for that?

Think like a Scientist

1. What different effects does the Sun have on humans?

2. How do plants use the Sun's heat and light?

3. Why is it a good idea to wear a coat in cold weather? Why would you not want a coat in hot weather?

Science Language that Students Need to Know and Use

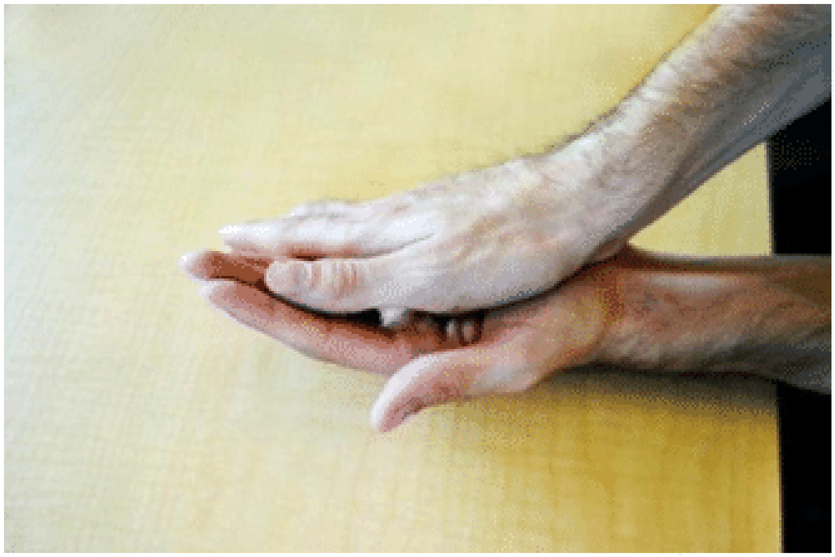
- **Temperature** - how much heat something has. It is usually measured in degrees.
- **Heat source** - something that produces heat.
- **Degrees** - marked measurement units on a thermometer.
- **Misconception** - misunderstanding or wrong idea.

5.2 Other Sources of Heat and Light

The Sun is not the only source of heat and light. One way to create heat is to use **mechanical** energy. **Mechanical** energy uses power from a person or animal. It can also be from the wind or another source. **Mechanical** energy does not plug into the wall or use a battery.

A hand held pencil sharpener is an example of something that uses **mechanical** energy. So is a bicycle pump. These objects use people power to do work. A windmill gets its energy from the wind. It can do work because of wind power. A cart might be pulled by a horse. Where does it get the energy to move? All these things use **mechanical** energy.

When we use tools like these, they produce **mechanical** heat - heat created by moving parts. This heat is caused by **friction** - the force that holds back the movement of a sliding object. When parts rub together, the **motion** makes things warm up. You have probably experienced this type of heat yourself.


Rubbing your hands together can warm them.

Try rubbing your hands together. Do they get warm? Now, rub them together fast and press hard. They get even warmer. This is an example of **mechanical** heat.

Machines - tools that do work-create **mechanical** heat. 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.

Mechanical heat can be a problem. If there is too much heat, the parts of a machine may not work properly. Or the heat may make the machine dangerous to use. We can reduce friction in machines using a **lubricant** - a substance that makes things slippery. Oil is a **lubricant**. We use oil to keep the parts of a car engine from heating up too much. What other substances make thing slippery? Soap, lotion, and even water can make things slippery.

Try It: Reduce Friction

- Put a thermometer between your palms and read the **temperature**.
- Next, rub your hands together hard and fast for 30 seconds.
- Quickly, place the thermometer between your palms again. What is their **temperature** now?

- Rest your hands for a while until they cool down.
- Now, put lotion on your hands. The lotion will **lubricate** your hands. It forms a slippery surface that lowers friction rub them together again. Can you feel the difference between the **lubricated** and non-**lubricated** surfaces?
- Check the **temperature** of your palms this time. What happened?
- Can you draw a conclusion about **lubricated** surfaces?

Another investigation you might try: “Will rubbing sandpaper on wood produce heat?” Design an investigation for that testable question. What other questions do you have about friction? Can you design investigations to find answers?

Friction can be damaging if it heats things up too much. Friction can even make objects so hot they begin to glow, or give off light. Friction can make things hot enough to cause a fire! But without friction, most things we do every day would be difficult or impossible.

Friction is an important force. Imagine having to walk everywhere on a sheet of slippery ice. Without friction between our feet and the ground, walking would be nearly impossible. Other tasks require friction as well. It would be impossible to hold a pencil or pull on a pair of socks without friction. Friction in a car’s engine isn’t a good thing. But, friction between the car’s wheels and the road is necessary in order for the car to move.

These photos show two ways that friction is useful:

These photos show two ways that friction can cause problems:

Electrical Heat and Light

You have seen a flashlight make light and felt a stove heat up. How do these devices make heat and light? 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. We talked about **mechanical** machines earlier. Another type of machine uses electricity to do work. We call these **electrical** machines. Just like **mechanical** machines, **electrical** machines can produce heat and/or light. Sometimes that is exactly what we want them to do. A light bulb is an **electrical** machine that produces light. Light bulbs help us see at night and in dark places. We want light bulbs to give off light. That's their job.

Most light bulbs also produce some heat. Choosing a bulb that produces very little heat can help us keep our homes cool and keep our fingers from being burned.

Can you think of other electric machines in your house or the world around you? Do they produce heat or light when they do their work? Some electrical machines have other work to do. A washing machine’s job is to clean our clothes. It uses electricity from the outlet in your house. The electricity gives the machine power to wash clothes. As the washing machine’s parts rub together, it produces a little heat, too. What causes that heat? That’s right, friction is responsible for that heat.

Other machines like televisions, computers and tablets produce light. They light up so you can see the images or pictures on their screens. If you feel a computer when it is turned off it may feel cool. Feel it again when it is on. That extra heat you feel is caused by the electricity flowing through the machine. Friction makes this happen, too. The friction of the electricity flow inside the wires makes the machine warm.

Try It: Electrical Heat

You will need several thermometers.

- Place thermometers on or near different **electrical** machines. You might choose a television, computer, lamp, or refrigerator.
- Make a prediction. Which machine will produce the most heat when it is working?
- Let the machines work for several minutes.
- Now check the thermometers. Which is the highest? Was your prediction correct?

You can also try testing the **temperature** of different **electrical** machines when they are off and again when they are on.

Solar Power

We know the Sun gives our planet heat and light. The Sun's energy can also be used to power machines. Some buildings have solar panels on their roofs. The solar panels trap the sun's energy. That trapped energy can light up buildings and power computers. It can even heat water!

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 **mechanica**l energy?
5. Name some benefits and drawbacks to **friction**.
6. Give some examples of times when you would not want a machine to produce heat or light. Explain why.

Science Language Students Need to Know and Use

- **Mechanical** - moves or runs without a battery or electricity.
- **Electrical** - uses a battery or household electricity to do work.
- **Lubricated** - a slippery surface.
- **Machine** - tools with fixed or moving parts for doing work.
- **Temperature** - how much heat something has. It is usually measured in degrees.
- **Heat source** - something that produces heat.
- **Degrees** - marked measurement units on a thermometer.
- **Misconception** - misunderstanding or wrong idea.