3rd Grade Science

for Utah SEEd Standards 2020-2021

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for Utah SEEd Standards

Utah State Board of Education OER
2020-2021

AUTHOR

USBE OER

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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

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

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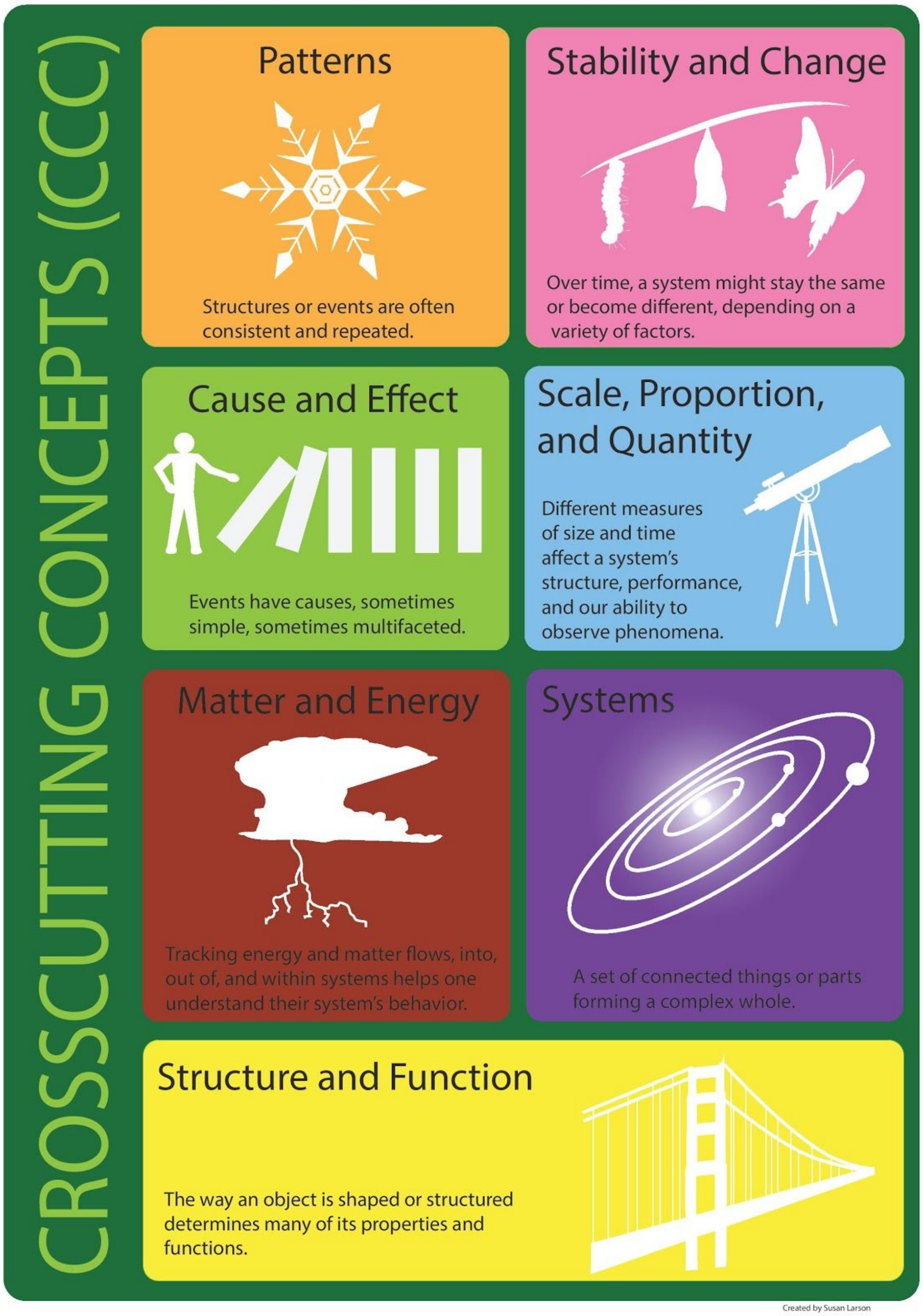
Cross Cutting Concepts

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/bFi

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CHAPTER 1

Strand 1: Weather and Climate

Chapter Outline

Image by Dan Fador, pixabay.com, CC0

Weather is a minute-by-minute, day-by-day variation of the atmosphere's condition on a local scale. Scientists record patterns of weather across different times and areas so that they can make weather forecasts. Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over a long period of time. A variety of weather related hazards result from natural processes. While humans cannot eliminate natural hazards, they can take steps to reduce their impact.

1.1 Weather Patterns (3.1.1)

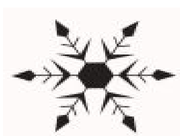
Explore this Phenomenon

Image by Megan Black, CC0

Observe the picture. How would you describe the weather in the picture?

3.1.1 Weather Patterns

3.1.1 **Analyze and interpret data** to reveal patterns that indicate typical weather conditions expected during a particular season. Emphasize students gathering data in a variety of ways and representing data in tables and graphs. Examples of data could include temperature, precipitation, or wind speed. (ESS2.D)



As you read this section focus on patterns. Think about how patterns of weather conditions help us to predict what the weather will be in the future.

Weather Conditions

Weather describes the day to day changes in the atmosphere around us. The atmosphere is the air that surrounds Earth. The air that is around you right now is part of the atmosphere.

Each day the weather changes. Sometimes it is hot. Other times we have snow storms. Weather keeps you guessing. It makes every day an adventure. Whatever the weather is doing now, it could be doing something else in a matter of hours.

Weather also can vary from place to place. Sometimes the places are very close together. It could be raining at your house, but dry at school a few blocks away.

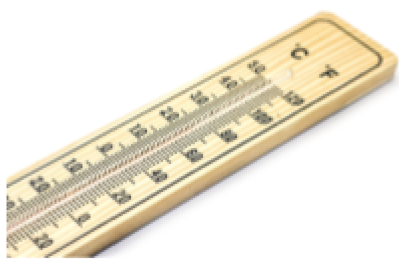
Weather is very tough to predict. Will it rain tomorrow? Maybe it will be sunny. What about the wind? How cold will it be? Those are all questions we want to know. Meteorologists are scientists who study weather and weather prediction.

Meteorologists measure many different weather conditions to describe and predict the weather. Temperature measures how hot or cold the air is around us. To describe the wind, we measure wind speed and wind direction. The wind direction tells us where the wind is coming from. We also measure precipitation. Precipitation is anything wet that falls from the sky. Precipitation can be rain, snow, sleet, or hail.

Weather Instruments

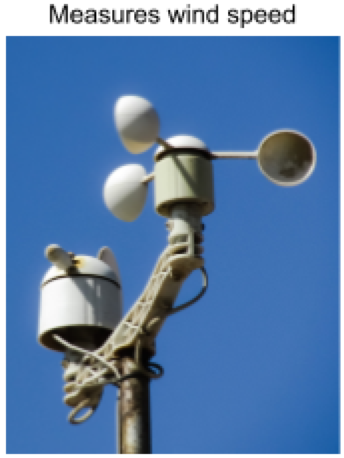
You might want to know how cold it is. You may need to know how fast the wind is blowing. Maybe it rained last night? Do you know how much? You have heard all these questions before. To answer these questions, we need to collect data. Meteorologists use instruments and computers to collect and analyze data in order to describe the weather and make predictions about the kinds of weather that might happen next. You can see some of the common instruments in these pictures.

Thermometer
Measures temperature



Rain Gauge
Measures amount of precipitation

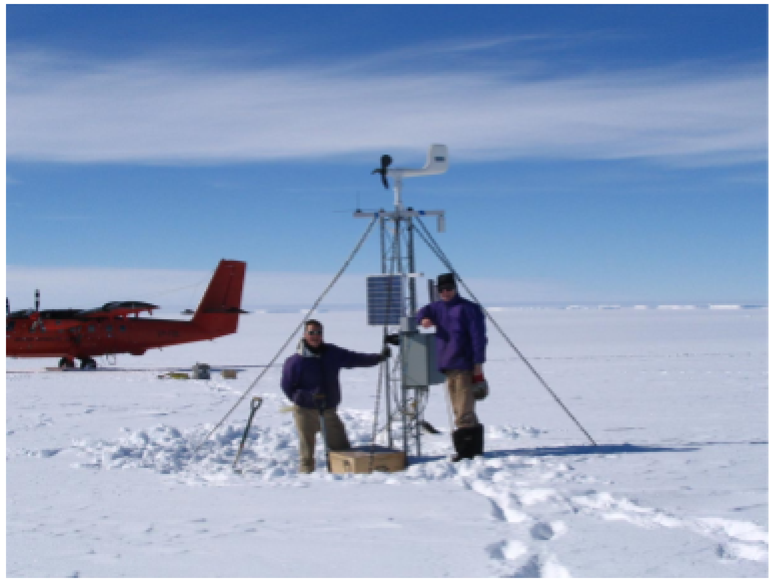
Anemometer
Measures wind speed



Weather Vane
Measures wind direction

Collecting Weather Data

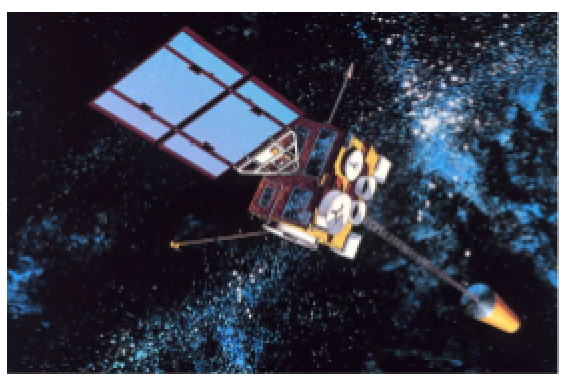
Weather instruments are used to collect data from all over the world at weather stations. Many weather stations are on land. Some float out in the oceans. Your school may have its own weather station. You can see what a weather station looks like in this picture.



An Antarctic Automatic Weather Stations Project AWS in Antarctica by William M. Connolley, https://en.wikipedia.org/wiki/Automatic_weather_station#/media/File:IMG_0430-aws-rothera_1200x900.jpg, CCBY-SA 3.0

Meteorologists also need to know about weather conditions high in the atmosphere. For this we use weather balloons. These balloons carry tools high into the air. Some data is even collected from outer space by weather satellites.

This weather balloon will rise into the atmosphere until it bursts. As it rises, it will gather weather data and send them to the surface.
(public domain)



Many weather satellites orbit Earth. They constantly collect and transmit weather data from high above the surface of the earth.
(public domain)

Weather Forecasts

Meteorologists analyze patterns of weather data from different times and areas so that they can make predictions about what type of weather might happen next. Look at the chart of weather conditions below. What happens to the wind speed before a snowstorm arrives in Salt Lake City?

Salt Lake City Weather Data

Date	Jan 21	Jan 22	Jan. 23	Jan 24	Jan 25	Jan 26	Jan 27
Temp	40°F	38°F	39°F	30°F	28°F	36°F	31°F
Wind	5 mph	15 mph	22 mph	6 mph	4 mph	21 mph	5 mph
Sky	sunny	cloudy	cloudy	snowy	sunny	cloudy	snowy

Meteorologists make predictions about what the weather will be. These predictions are called weather forecasts. People watch the weather forecast on TV or look up the weather online to learn what the weather will be in the future. People hope that the forecast is accurate. Sometimes the forecast is wrong. For example, strong winds, changing temperatures, and dropping air pressure usually come before a storm in Utah. But sometimes, at the last minute, the storm takes a different path and misses us.

Putting It Together

Image by Megan Black, CC0

Observe the picture again. Think about what you have learned about describing and measuring the weather. What are the weather conditions in this picture? What is your evidence?

1.2 Climate Patterns (3.1.2)

Explore this Phenomenon

Satellite Image of Earth in July

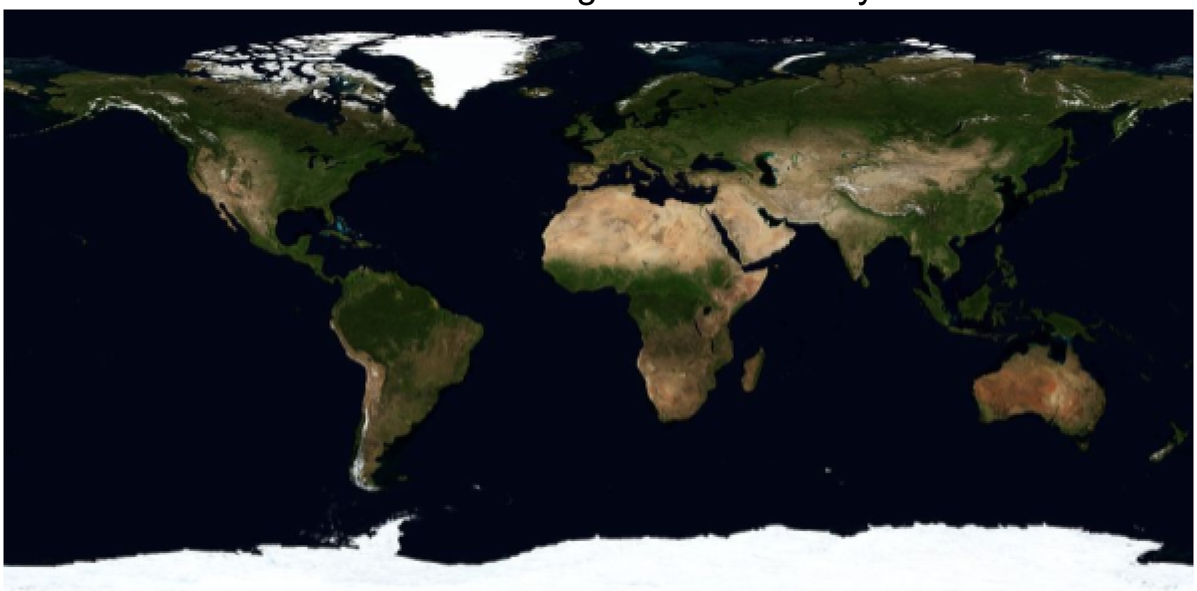


Image from WikiImages, pixabay.com, CC0

This picture shows Earth from space in the month of July. Look at the different colors on the continents. What patterns do you notice?

Make an initial claim. What do you think causes these patterns?

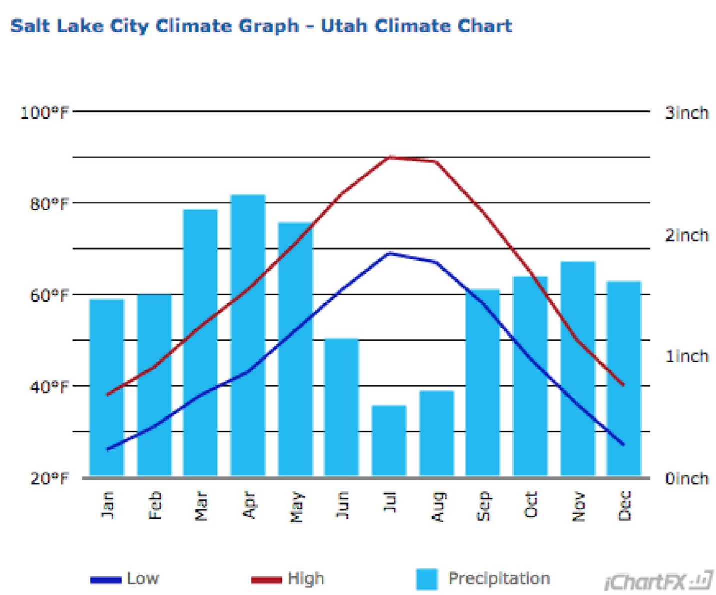
3.1.2 Climate Patterns

3.1.2 **Obtain and communicate information** to describe climate patterns in different regions of the world. Emphasize how climate patterns can be used to predict typical weather conditions. Examples of climate patterns could be average seasonal temperature and average seasonal precipitation. (ESS2.D)

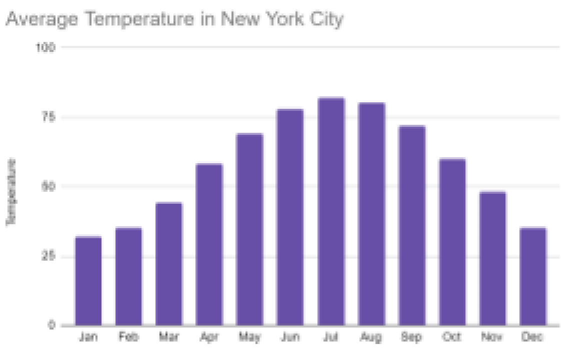
As you read this section, focus on patterns. Think about how different regions of the world have different climate patterns.

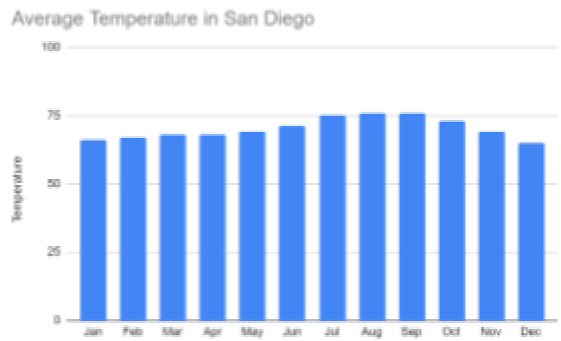
Climate

Weather is a specific event like a rainstorm or hot day. Weather happens over a short period of time. It can be measured every hour or each day. Climate is different. Climate describes the average weather conditions in a place over a long period of time, about 30 years. The climate where you live is made up of all the different weather patterns that usually happen there. For example, the climate in Salt Lake City is cold and snowy in the winter and hot and dry in the summer.



We can also use climate patterns to compare two places. Look at the temperature graphs for New York City and San Diego. If you wanted to go somewhere warm in January, which city would you choose to visit?





Graphs by Megan Black, CC0

Climate Zones

There are many different types of climates on Earth. Climate scientists use patterns of temperature and precipitation to split the Earth into five main types of climates.

Tropical climates are found around the equator. These climates have warm temperatures year round. Tropical climates may be very wet all year or have a wet and a dry season.

Image by blackend464, pixabay.com, CC0

Dry climates receive very little rainfall. Deserts are found in dry climates. Deserts receive less than 10 inches of rain or snow per year.

Image by Jill Wellington, pixabay.com, CC0

Temperate climates have mild temperatures. The weather is not too hot and not too cold. Areas with temperate climates are usually found on the edges of continents.

Image by Free-Photos, pixabay.com, CC0

Continental climates have hot summers and cold winters that include snowstorms and strong winds. Areas with continental climates are found in the middle of continents.

South Side of Jasper National Park by Frank Kovalchek, https://commons.wikimedia.org/wiki/File:South_side_of_Jasper_National_Park.jpg, CC-BY

Polar climates are found near the North and South Poles. The summers are very cool. The winters are extremely cold. Polar climates have low precipitation because it is so cold.

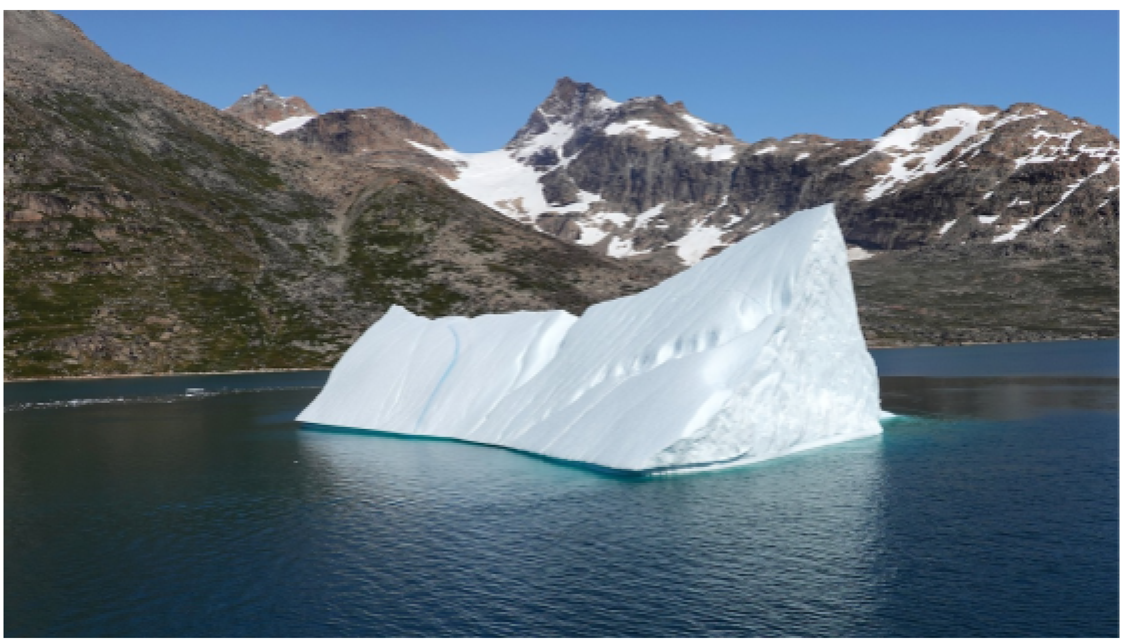


Image by Aline Dassel, pixabay.com, CC0

Putting It Together

Satellite Image of Earth in July

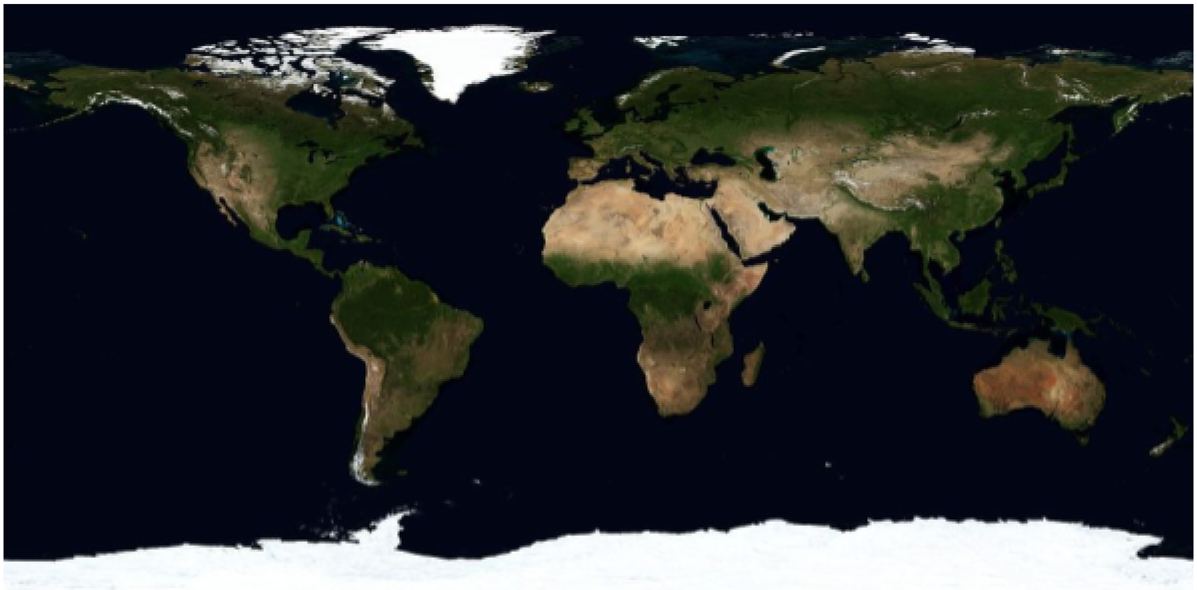


Image from WikiImages, pixabay.com, CC0

Let's observe the picture of the Earth in July again. Look for patterns in the colors on the continents.

Think about what you have learned about climate and climate zones. What causes these patterns?

1.3 Weather Hazards (3.1.3)

Explore this Problem

Flooding in Cedar Rapids, IA by U.S. Geological Survey, https://flic.kr/p/4XbesH, public domain

This picture was taken in Cedar Rapids, Iowa when the Cedar River flooded. The Cedar River runs through the middle of the city.

Observe the picture. What problems has the flood caused in this neighborhood?

As you read this chapter, think about possible solutions to the problems you identified.

3.1.3 Weather Hazards

3.1.3 **Design a solution** that reduces the <u>effects</u> of a weather-related hazard. *Define the problem, identify criteria and constraints, develop possible solutions, analyze data from testing solutions, and propose modifications for optimizing a solution*. Examples could include barriers to prevent flooding or wind-resistant roofs. (ESS3.B, ETS1.A, ETS1.B, ETS1.C)

As you read this section focus on how weather-related hazards affect people's lives. Think about how humans can take steps to reduce the hazards caused by weather.

Severe Weather

It was 12:15 PM on August 11, 1999. Fourth grade students at Rosamond Elementary School in West Jordan, Utah went outdoors to observe the weather to record information for their school's website. Today's report would be different. A strange phenomenon was about to occur. It was very windy with an air temperature of 70˚F. Looking to the west, the students noticed dark clouds over Herriman, Utah. The students took two pictures of the dark clouds, then returned to class and entered their information into the computer. An hour later, the students were shocked to hear that a thunderstorm and a tornado had struck downtown Salt Lake City, causing much damage. As they watched the news, they realized the storm had begun with hailstones in Herriman at about 12:00 PM. Their pictures showed the beginning of the thunderstorm that formed the tornado.

Dark Clouds Over Herriman, CC0

Thunderstorms and tornadoes are two types of severe weather. Severe weather is any type of dangerous weather that can cause damage. Blizzards, floods, and droughts are also examples of severe weather.

During thunderstorms strong winds can knock down trees and damage homes. Hail can fall from the sky and damage cars. Lightning might cause trees or buildings to catch fire.

Image by Skeeze, pixabay.com, CC0

A tornado is a column of spinning air that extends from the base of a thunderstorm. Tornadoes occur during very strong thunderstorms. Some tornadoes are strong enough to pick up buildings and move them. Sirens warn people of approaching tornadoes so that they can take shelter below the ground in basements.

Image by Skeeze, pixabay.com, CC0

Blizzards are strong winter storms. Heavy snowfall and strong winds make driving during blizzards very dangerous. The heavy snowfall can cause trees to fall and even roofs to collapse. In snowy areas, many houses have very steep roofs. This helps the snow to slide off so that the roof does not collapse.

Image by janeb13, pixabay.com, CC0

Severe flooding is caused by heavy rain and raging rivers. Flooding can damage roads and leave people without homes. People build barriers with sandbags to prevent water from going over the banks of a river. Some houses are built on stilts so that floods do not ruin the inside of the house.

Image by Hans Braxmeier, pixabay.com, CC0

When too little rain or snow falls in an area, it can cause a drought. Droughts can cause farmers to lose their crops. Droughts can also affect plants and animals that depend on water in rivers and lakes. It is important to conserve water during droughts.

Image by Couleur (Ilona), pixabay.com, CC0

People cannot control severe weather; however we can do things to prepare for severe weather. Meteorologists use tornado warnings to tell people to find shelter immediately. People can make sure they have extra food and water before a blizzard in case they are not able to leave their house.

Engineering for Severe Weather

To design a solution for damage caused by severe weather, engineers begin by observing how weather related hazards affect people. These observations can lead to a problem.

Before beginning to solve the problem, engineers do research. They study the problem or ask people how the problem affects them. They consider how others have tried to solve the problem. This helps them to define the problem.

Engineers write end goals that help them know they have solved the problem. These goals are called the criteria. A successful solution will meet the criteria for the problem.

An engineer can brainstorm a great idea, but it still may not work. All engineering solutions are limited by the available materials and resources. The limits on a solution are called the constraints. Cost and time are often constraints that engineers need to consider.

After defining the problem, the criteria, and the constraints, engineers begin working on solutions. They brainstorm many possible solutions and develop plans. They evaluate their ideas by thinking about how well the possible solutions meet the criteria and constraints.

Often engineers will build a model, or prototype, of their solution. They test their prototype under a range of possible scenarios to see how well the solution will work. Using data from tests, engineers can modify their design. They continue to test designs and ideas in order to determine which design best solves the problem.

Putting It Together

Flooding in Cedar Rapids, IA by U.S. Geological Survey, https://flic.kr/p/4XbesH, public domain

Observe the picture of the flooded neighborhood. One problem is that the mailman cannot deliver the mail. What other problems has the flood caused?

Brainstorm a possible solution to one of the problems that you identified. Draw a picture or explain your idea.

CHAPTER 2

Strand 2: Effects of Traits on Survival

Chapter Outline

Organisms (plants and animals, including humans) have unique and diverse life cycles, but they all follow a pattern of birth, growth, reproduction, and death. Different organisms vary in how they look and function because they have different inherited traits. An organism's traits are inherited from its parents and can be influenced by the environment. Variations in traits between individuals in a population may provide advantages in surviving and reproducing in particular environments. When the environment changes, some organisms have traits that allow them to survive, some move to new locations, and some do not survive. Humans can design solutions to reduce the impact of environmental changes on organisms.

2.1 Life Cycles (3.2.1)

Explore this Phenomenon

All images from pixabay.com, CC0

Observe these four pictures carefully. What do they have in common? What is different?

3.2.1 Life Cycles

3.2.1 **Develop and use models** to describe changes that organisms go through during their life cycles. Emphasize that organisms have unique and diverse life cycles but follow a pattern of birth, growth, reproduction, and death. Examples of changes in life cycles could include how some plants and animals look different at different stages of life or how other plants and animals only appear to change size in their life. (LS1.B)

As you read this section think about how living things change throughout their lives. Focus on the similarities and differences in the way that different plants and animals change.

Life Cycles

All living things grow and change throughout their lives. This is called a life cycle. The word cycle means it repeats itself. The cycle includes birth, growth, reproduction, and death. Plants and animals both follow this pattern. It is important for plants and animals to reproduce or they will not be able to survive and could go extinct.

Animal Life Cycles

Earth has many kinds of animals. Each follows the same life cycle, but the way they grow is not the same. Horses begin as small animals that grow larger in size. Baby horses look similar to adult horses. Other animals, like insects, go through changes that make them look completely different from the time they are born until they become adults. An example of one insect that goes through many changes during the growth cycle is the butterfly.

Birth

Butterflies began as eggs on a leaf. They are very tiny. When butterflies are born they are called larva. At this stage the larva is commonly called a caterpillar.

Eggs by A. Poulos, https://flic.kr/p/4zWXcp, CC-BY

Image by Jan Haerer, pixabay.com, CC0

Growth

During this time of life the larva eats. It grows bigger and bigger until it is ready for a big change called metamorphosis. During this part of its growth cycle the larva is called a pupa. The pupa builds a chrysalis around itself. It does not move or eat in the chrysalis, but it does change into an adult butterfly. The butterfly is now finished with the growth stage of life. The pictures show a chrysalis and a Monarch butterfly.

Image by Ian Lindsay, pixabay.com, CC0

Image by Bill Barlow, pixabay.com, CC0

Reproduction

The butterfly is now ready to reproduce. The female butterfly searches for a male mate. Then, they look for a good place to lay the eggs. The female butterfly lays many eggs close together on a leaf.

Death

All butterflies die. It can happen at any time for many different reasons. Some might be eaten. Others might not have enough food to eat. They can also be knocked off a leaf and will not be able to complete the pupa stage. Others will complete all phases of their life and die because they are old.
https://www.monarch-butterfly.com/life-span.html

Plant Life Cycles

Another growth cycle seen in nature is from plants. Plants do not all grow the same way, but they follow the same pattern of animals through birth, growth, reproduction, and death. We are going to follow the growth cycle of an apple tree.

Birth

We do not think of plants being born because it is a cycle. An apple tree's life cycle begins with a seed. The seed does not look anything like a tree when it starts growing. Look at the pictures, you can see that the tree has a lot of growing to do between birth and the end of the tree's life.

Growth

A tree begins as a seed sprouts and starts to grow. It develops roots, stems, and leaves. It starts to spread by growing branches, which spread out and grow more leaves.

Image by TatsianaVusava, pixabay.com, CC0

Image by DarkWorkX (Dorothe), pixabay.com, CC0

Reproduction
Apple trees reproduce by producing fruit (apples). The reproduction cycle begins when the tree produces blossoms in the spring. The blossoms grow into apples with seeds inside. The seeds will someday become a new apple tree.

Death
Apple trees can die at any time during their life cycle. The tree might be eaten by harmful insects. It might get sick from bacteria. It could fall in a storm. Some trees are cut down. If they get too much sun, not enough sun, too much water, or not enough water the apple tree can die.

Putting It Together




All images from pixabay.com, CC0

After learning about the life cycle of organisms, what do these four pictures have in common?

How are they related to the other animals and plants you learned about?

Draw a model that shows the life cycle of a frog.

2.2 Inherited Traits (3.2.2)

Explore this Phenomenon

Image from Michael Schwarzenberger (blickpixel), pixabay.com, CC0

Look at the picture of the baby monkey and his mother. What do the monkeys have in common?

What is different about the monkeys?

Why do you think they do not look exactly the same?

3.2.2 Inherited Traits

3.2.2 **Analyze and interpret data** to identify patterns of traits that plants and animals have inherited from parents. Emphasize the similarities and differences in traits between parent organisms and offspring and variation of traits in groups of similar organisms. (LS3.A, LS3.B)

As you read this section, think about the patterns that help us to notice similarities and differences between parents and their offspring.

Inheritance

Has anyone ever said you look just like your parents? You probably have some traits in common with each of your parents. Traits are characteristics you inherit from your parents. Your parents also have traits that they inherited from their parents, your grandparents. What does the word inherit mean? To inherit is to receive something from someone who came before you. You can inherit traits. For example, you can inherit a parent's eye color, hair color, or even the shape of your nose and ears!

Many characteristics of living things are inherited from their parents. Sometimes the traits are easy to see, like the spots on a leopard or the claws of a cat. Look at the picture of the mother dog, father dog, and their offspring. What do you see in the offspring that are the same as the mother? What do you see in the offspring that are the same as the father? Although these puppies have the same two parents they look different. These differences are called variations. Differences in paw size, tail length, or hair coloring are examples of variations in traits.

Male Dog

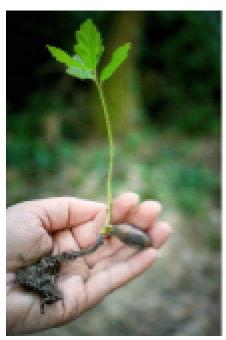
Female Dog

Offspring

Images from pixabay.com, and M.Rowe, CC0

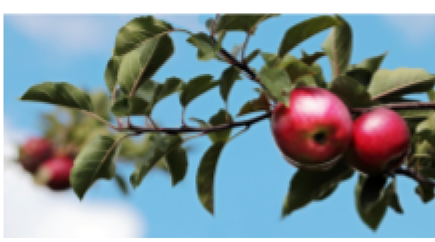
Not all the offspring from the same parents look the same. The offspring have variation in their traits because they have different inherited information. Each offspring gets some information from one parent and some information from the other parent. Because the offspring do not get the same information as each other, they do not look exactly the same.

Plants also inherit traits from their parents. Look at the picture of the young tree called a sapling. Look at the pictures of the trees. Which tree is the sapling's parent? How do you know?



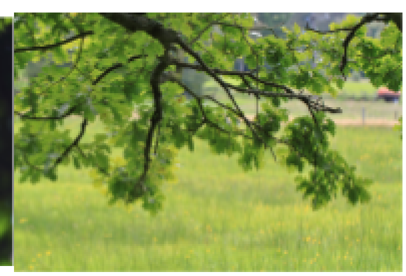
Sapling

All images from pixabay.com, CC0



Apple Tree

Maple Tree



Oak Tree

Leaf shape can help you figure out which tree is the parent tree. The sapling and the oak tree have the same shaped leaves. Leaf shape is one example of a trait that a plant offspring inherits from its parents. Being tall or short, having large or small fruit, and flower color are other examples of traits that plant offspring inherit.

Just like animals, plants also have differences in their traits called variations. In a field of sunflowers you can observe that each sunflower is different. Some may be taller than others, some may have smaller petals. Each sunflower is different because of variations in the traits that the sunflowers inherited from their parent sunflowers.

Image by Susanne Jutzeler (suju), pixabay.com, CC0

Putting It Together

Image from Michael Schwarzenberger (blickpixel), pixabay.com, CC0

Let's go back to your answers to the questions about the baby monkey and his mother. What causes the monkeys to have different traits?

Based on what you observe in this picture, what do you think the father of the baby monkey looks like?

2.3 Environmental Traits (3.2.3)

Explore this Phenomenon

Image by Markus Spiske (markusspiske), pixabay.com, CC0

These carrots came from the same garden, but they do not look alike. Why do you think this happened?

3.2.3 Environmental Traits

3.2.3 **Construct an explanation** that the environment can affect the traits of an organism. Examples could include that the growth of normally tall plants is stunted with insufficient water or that pets given too much food and little exercise may become overweight. (LS3.B)

As you read this section, focus on the crosscutting concept of cause and effect. Think about how the environment can affect the traits of a plant or an animal.

Environmental Traits

The environment can affect the traits of an organism. As living things grow and develop they will respond to the world around them. For example, plants that would normally be tall might be short because they do not have enough water. In Utah, larger trees are often found along river beds where the trees get more water.

The amount of food an animal eats can change its size. Pets that are given too much food may become overweight. Animals that are not given enough to eat may become thin.

Images by Quinn Kampshroer and Hanish Narang, pixabay.com, CC0

Learned Behaviors

Behaviors can be learned. They are not always passed down from parents. Learning to speak a second language is learned. It has to be heard and practiced. Playing basketball, swimming, riding a bike, and handwriting are learned behaviors.

Behaviors can also be changed by the environment. One famous experiment was conducted by a Russian scientist named Ivan Pavlov. Every time he gave food to his dogs he rang a bell. The dogs learned that a ringing bell meant they were going to eat. After a while the dogs started to drool when they heard a bell, even if the food was not given to them!

Inherited and Environmental Traits

We often see examples of both inherited and environmental traits affecting the behaviors of an organism. For example, a horse is born with inherited traits from its parents. It may have inherited long legs from its mother. It can also have environmental traits that change how it grows. If it is trained to jump by a trainer, its legs will become stronger. Someday it may become an award winning hurdle horse.

Images by Wayne Decker (wnrkmedec) and Skeeze, pixabay.com, CC0

Putting It Together

Image by Markus Spiske (markusspiske), pixabay.com, CC0

Let's return to the carrots that you observed in the beginning of this section. These carrots came from the same garden, but they do not look alike.

What may have caused these carrots to have different lengths?

Why is it important to think about how the environment affects plants if you plan to plant a garden?

2.4 Traits and Survival (3.2.4)

Explore this Phenomenon

Image by stux, pixabay.com, CC0

Observe this picture. What do you see? Look carefully. Were you fooled the first time?

3.2.4 Traits and Survival

3.2.4 **Construct an explanation** showing how variations in traits and behaviors can affect the ability of an individual to survive and reproduce. Examples of traits could include large thorns protecting a plant from being eaten or strong smelling flowers attracting certain pollinators. Examples of behaviors could include animals living in groups for protection or migrating to find more food. (LS2.D, LS4.B)

As you read this section focus on cause and effect. Think about how differences in a living thing's traits or behaviors can affect its ability to survive.

Physical Traits

Remember that in section 3.2.2 you learned that a trait is a characteristic. Individuals of the same species will have variations in their traits. Sometimes these variations in traits will help a plant or an animal to survive. It is important that a plant or animal survives long enough to reproduce. If they do not reproduce the population of plants or animals living in an area will die off. The longer plants and animals live, the more offspring they can have. More offspring means the entire population has a better chance of survival.

A variation in an animal's trait can help that animal to survive. A mouse that has brown colored fur is better camouflaged in a forest than a mouse with gray colored fur. Since the brown mouse blends in, it is more difficult for a predator, such as an owl, to see it. The brown mouse is more likely to survive than the gray mouse. If the brown mouse survives until it is an adult, it can find a mate and reproduce.

Images by Alexis_Fotos and Silvia (sipa), pixabay.com, CC0

Plants also have traits that help them to survive. Rose bushes have thorns to protect them from being eaten. They also have a strong scent and bright petals that attract bees and insects. The rose bushes need the bees and insects to pollinate their flowers so they can reproduce. Rose bushes that do not have bright, strong smelling flowers will attract fewer bees and insects. They may not be pollinated, and not able to reproduce.

Images by Dieter_G and Gabriele Lässer (webentwicklerin), pixabay.com, CC0

Behavioral Traits

Images obtained from pixabay.com, CC0

Animals sometimes live in groups to help them survive. Wolves live in packs because it helps them hunt for food. Notice in the picture that the wolves work together to take down a bison. A lone wolf may not live as long as a wolf that lives in a pack because it is not able to hunt as well.

Putting It Together

Image by stux, pixabay.com, CC0

This picture is actually a butterfly! Use what you have learned to explain how the butterfly's traits might affect the butterfly's ability to survive.

2.5 Habitats and Survival (3.2.5)

Explore this Phenomenon

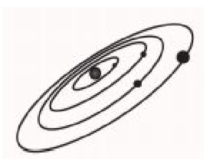
Image by USGS (public domain)

Black Bear Lake Louise by Harry Barrison, https://commons.wikimedia.org/wiki/File:Black_Bear_Lake_Louise.jpg, CC BY-SA

Polar bears live in polar climates and hunt in the ocean. They mostly eat seals. Brown bears live in warmer climates. They eat nuts, berries, and fish. What traits do each of these bears have that help them survive in their habitat?

3.2.5 Habitats and Survival

3.2.5 **Engage in argument from evidence** that in a particular habitat (system) some organisms can survive well, some survive less well, and some cannot survive at all. Emphasize that organisms and habitats form systems in which the parts depend upon each other. Examples of evidence could include needs and characteristics of the organisms and habitats involved such as cacti growing in dry, sandy soil but not surviving in wet, saturated soil. (LS4.C)



As you read this section, focus on the crosscutting concept of systems. In a system, different parts work together. Think about how plants and animals are a part of a habitat system.

Habitats

A habitat is the place or environment where a plant or animal lives and grows. The habitat of a fish is the pond, river, or ocean where they live. The habitat of a raccoon is often in a wooded area. Jack rabbits live in grassy, open areas. Cacti live in desert habitats. Willow trees are often found near wetlands. Each of these animals and plants can survive in their habitat, but may not survive in a different habitat.

Plants and Their Habitats

Look at the pictures of the plants. Cactus leaves look like needles. Their shape helps the plant live in dry habitats. The needle-like leaves help it to not lose water to the air.

Other plants grow better in habitats that are wet and shady. These plants often have very large leaves. They do not have to worry about losing water through their leaves. These plants also need large leaves to gather as much sunlight as possible because plants need sunlight to make food.

In contrast, the cactus leaves can be much smaller. Deserts receive a lot of sunlight. The cactus does not need really large leaves to collect sunlight. A cactus could not survive in a wet and shady habitat. Its needle-like leaves could not collect enough sunlight for the cactus to make the food it needs to survive.


Images by Javier Robes (Thisabled) and Spencer Wing, pixabay.com, CC0

Animal and Their Habitats

Different animals are also better able to survive in different habitats. A snowshoe rabbit lives in cold habitats where there is snow on the ground for much of the winter. The snowshoe rabbit has small ears and broad feet. Its smaller ears help it from losing too much body heat. Its broad-sized feet help it to travel over the snow.

A jackrabbit lives in the hot, dry areas of the southwest. It has long, large ears and powerful hind feet. Its large ears allow extra heat to escape so the jackrabbit does now become too hot. Its powerful hind legs allow it to outrun predators. Even though they are both members of the rabbit family, the special traits of the snowshoe rabbit and jackrabbit allow them to survive in different habitats.

Images by Skeeze, pixabay.com, CC0

Putting It Together

Image by USGS (public domain)

Black Bear Lake Louise by Harry Barrison, https://commons.wikimedia.org/wiki/File:Black_Bear_Lake_Louise.jpg, CC BY-SA

Let's return to the pictures of the polar bear and black bear. Observe the physical traits of each bear. Do you think a polar bear could survive in a black bear's habitat? Explain your reasoning.

2.6 Environmental Change (3.2.6)

Explore this Problem

Image by Hans Braxmeier, pixabay.com, CC0

The picture shows an excavator making a new ski run at a ski resort. Ski resorts build new runs in the summer so that they will be ready for people to use in the winter.

Observe the picture. How does building a ski run change the environment?

3.2.6 Environmental Change

3.2.6 **Design a solution** to a problem caused by a change in the environment that impacts the types of plants and animals living in that environment. *Define the problem, identify criteria and constraints, and develop possible solutions*. Examples of environmental changes could include changes in land use, water availability, temperature, food, or changes caused by other organisms. (LS2.C, LS4.D, ETS1.A, ETS1.B, ETS1.C)

As you read this section think about how changes in an environment might affect the plants and animals living in that environment. Also consider how people can help the plants and animals that are affected by environmental changes.

Changes in the Environment

Changes in an environment can affect the plants and animals living in the environment. If an environment changes, some plants and animals will still be able to survive in the changed environment. Other plants and animals will not be able to survive. These plants and animals may move to new locations or may die.

Fire can change an environment. In 1988 Yellowstone Park had a huge fire. Some small animals died in the fire. Large animals were able to escape. The park changed after the fire. New plants grew in meadows where the forests had burnt down. Many animals returned and were able to survive in the changed environment. Moose, however, were not able to survive well after the fire because the willow plants that they depended on for food in the winter had died in the fire.

Yellowstone Fire, public domain

Beautiful Meadow in Yellowstone National Park by Jrmichae, https://commons.wikimedia.org/w/index.php?curid=34222902, CC BY-SA

When too little rain or snow falls in an area, it can cause a drought. Droughts can affect plants and animals that depend on water in rivers and lakes. If the level of a lake goes down, the plants living on the shores of the lake may die. This can affect the animals that need the plants for food and shelter.

California Drought Dry Riverbed, public domain

People also change the environment. To build new houses people must clear the land. Trees need to be cut down and smaller plants are dug up to make space for the houses. The animals living in the area must move to a new area because they no longer have the plants they need for food and shelter.

Image by Paul Brennan, pixabay.com, CC0

Even animals can change an environment. Beavers change their habitat by cutting down trees and building dams in rivers. When a beaver dams a river, it slows the river down. A pond forms. Plants and animals that need fast moving water can no longer live there. For example, trout that live in fast moving water will not survive in the new beaver pond. Plants and animals that survive well in ponds will move into the area. For example, turtles prefer slow moving water. After a beaver dams a river, more turtles may be found in the area.

Beaver dam in Lassen Volcanic National Park by Walter Siegmund, https://en.wikipedia.org/wiki/Beaver_dam#/media/File:BeaverDam_8409.jpg, CC-BY 2.5

Look around your community. Can you find an area where the environment has changed recently? What caused the change?

Responding to Changes

Natural environments are important for the plants and animals that depend on the environment for their habitat. When environments change people sometimes design solutions to help the plants and animals living there to survive.

The Swaner Nature Preserve in Park City, Utah used to be land used for ranching and farming. Members of the community purchased the land so that it could return to a natural wetland area. Many people worked together to fill in old irrigation ditches, build areas for ponds, and plant willow shrubs along the banks of rivers. Overtime plants and animals returned to the area. Swaner Preserve is now an important habitat for many of Utah's wetland species, including the tiger salamander.

Tiger Salamander by U.S. Fish and Wildlife Services, https://flic.kr/p/bxJ5L9, CC-BY

Sometimes environments change quickly, in June 2010 oil spilled into Red Butte Creek in Salt Lake City, Utah. The oil spill harmed fish, birds, and insects. People needed to design solutions for cleaning up the oil and saving wildlife. People used booms to create dams to stop the oil from flowing down the creek. Ducks that were covered in oil were taken to the Hogle Zoo so that workers could clean the oil off of their feathers.

Putting It Together

Image by Hans Braxmeier, pixabay.com, CC0

Let's look at the ski run again. How does building a new ski run impact the plants and animals living in that environment?

Engineers can design ways to prevent or minimize damage to plants and animals that occur because of a change in their environment.

In the ski run situation, what is the problem?
What are some solutions that you can think of to solve this problem? Write them down.

Next, write end goals that will help you know you have successfully solved the problem. These are your criteria for success.

Now, write the limitations or constraints you have to solve the problems such as cost, time, and materials.

Which of your possible solutions best meets the items you listed in your criteria and constraints?

Draw a model of your best solution. Explain why it is the best solution for your problem.

CHAPTER 3

Strand 3: Force Affects Motion

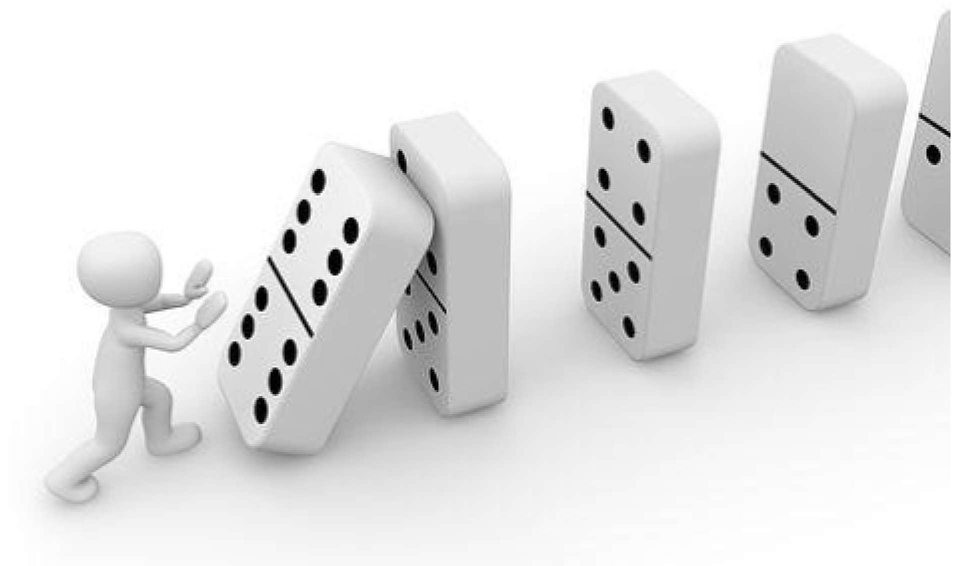
Chapter Outline

Image by Skeeze, pixabay.com, CC0

Forces act on objects and have both a strength and a direction. An object at rest typically has multiple forces acting on it, but they are balanced, resulting in a zero net force on the object. Forces that are unbalanced can cause changes in an object's speed or direction of motion. The patterns of an object's motion in various situations can be observed, measured, and used to predict future motion. Forces are exerted when objects come in contact with each other; however, some forces can act on objects that are not in contact. The gravitational force of Earth, acting on an object near Earth's surface, pulls that object toward the planet's center. Electric and magnetic forces between a pair of objects can act at a distance. The strength of these non-contact forces depends on the properties of the objects and the distance between the objects.

3.1 Forces and Motion (3.3.1)

Explore this Phenomenon



Adapted from image by Peggy und Marco Lachmann-Anke (3D_Maennchen), pixabay.com, CC0

A line of dominoes stands still, but if one domino is touched the rest will fall down.

What causes the dominoes to stand still? What causes the dominoes to fall?

3.3.1 Forces and Motion

3.3.1 **Plan and carry out investigations** that provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Emphasize investigations where only one variable is tested at a time. Examples could include an unbalanced force on one side of a ball causing it to move and balanced forces pushing on a box from both sides producing no movement. (PS2.A, PS2.B)

In this chapter, think about the effects of balanced and unbalanced forces on the motion of objects.

Force and Motion

Forces cause objects to be pushed or pulled. Forces can cause an object at rest to start moving. Forces can cause objects to speed up or slow down. Forces even cause a moving object to stop. Forces can also cause a change in direction. When a force is applied to an object, the object may change its speed, its direction, or both.

We know that changes in motion requires a force. How much an object's motion changes when a force is applied depends on two things. It depends on the strength of the force. It also depends on the object's weight.

Think about some simple tasks you may regularly do. You may pick up a baseball. This requires only a very small force. Next, you toss the baseball to a friend. This takes a little larger force. With an even bigger force, you can throw it to your other friend far across the field. The larger the force applied, the bigger the change in motion.

Image by Keith Johnston (KeithJJ), pixabay.com, CC0

Think about these actions if instead of the baseball, you now had a bowling ball. What kind of force would it take to pick it up? Would it be more than the force needed to pick up a baseball? What about if you were to toss the bowling ball? Is it even possible to throw the bowling ball any distance? This demonstrates how the size of the force depends on the object's weight. As you increase the weight of the object, the harder it is to cause a change in its motion.

Image by Michal Jarmoluk, pixabay.com, CC0

Balanced and Unbalanced Forces

Most objects on Earth have at least two forces acting on them. Do you know what one of them is? Of course, that force is gravity.

How many forces do you have on you right now? Gravity pulls you down toward the center of Earth. Your legs push back with an upward force. They hold you up against the pull of gravity.

Look at the example of the book resting on the table. Gravity pulls the book downward. At the same time, the table pushes the book upward. The table opposes the pull of gravity. If not, the book would fall to the ground. The two forces combine to hold the book in place. The book is not moving because the forces are balanced. When we think about all the forces acting on an object we call the combined forces the net force. Since the force of gravity and the force of the table on the book are balanced, the net force is zero and the book does not move.

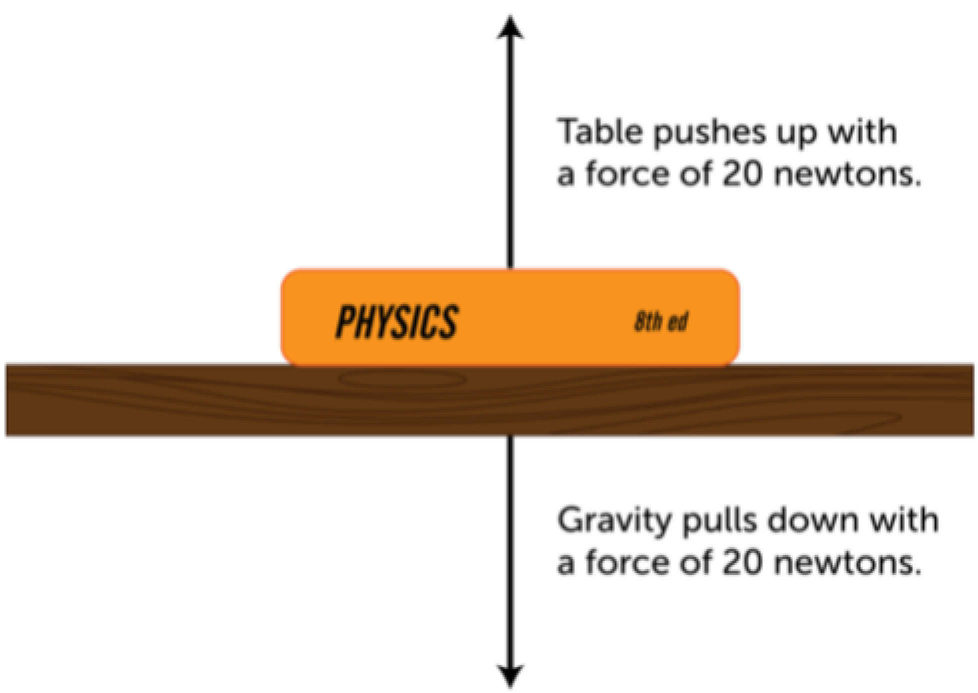
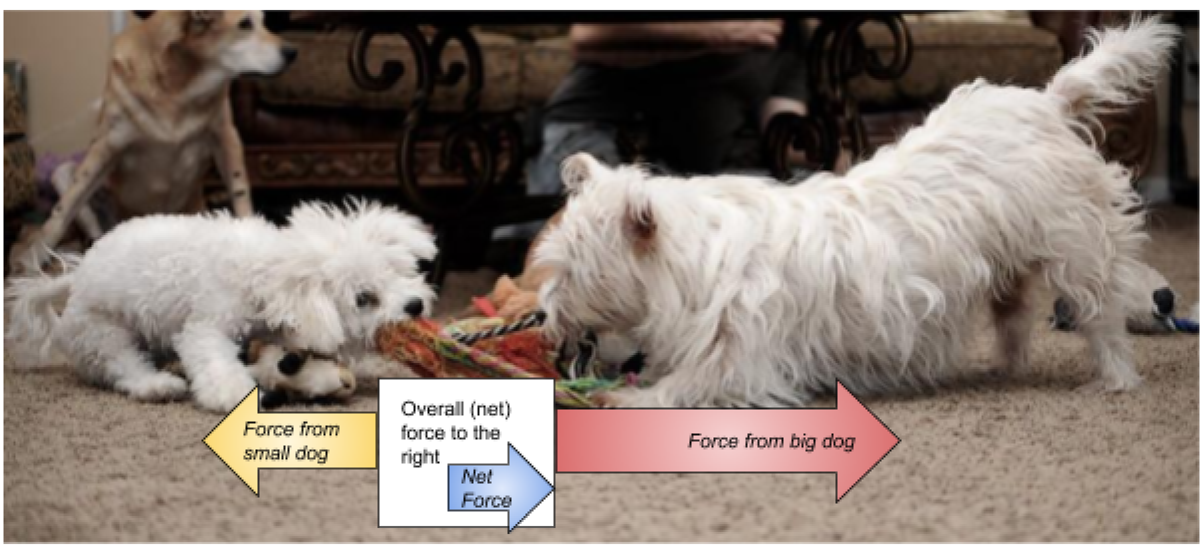


Image by Christopher Auyeung, CK-12 Foundation, CC BY-NC 3.0

Situations like these are common. Can you think of objects sitting on shelves or tables? These are all examples of balanced forces. Thanks to balanced forces objects stay where you put them.

Woof! Woof! Look at the dogs playing tug-of-war. Both dogs are pulling on the rope. Each pulls in an opposite direction. One is pulling on the rope to the left. The other dog is pulling on the rope to the right. These forces are not equal. Therefore, they are not balanced.

What does it mean when the forces are not balanced? The net force is greater than zero. The net force on the rope is bigger to the right. The rope will be pulled by the bigger dog to the right. The rope will move because the forces pulling on the rope are unbalanced forces. Anytime you have an unbalanced force acting on an object, the object’s motion will change.



Adapted from *Tug of War!* by Mathew Cerasoli, https://flic.kr/p/aSYNna, CC-BY

Putting It Together

Adapted from image by Peggy und Marco Lachmann-Anke (3D_Maennchen), pixabay.com, CC0

A line of dominoes stands still, but if one domino is touched the rest will fall down.

Using your knowledge of balanced and unbalanced forces, explain what causes the dominoes to stand still and what causes the dominoes to fall.

3.2 Patterns of Motion (3.3.2)

Explore this Phenomenon

Image by Arek Socha, pixabay.com, CC0

When a pebble is dropped in water, circular rings form.

What causes this pattern to form?

3.3.2 Patterns of Motion

3.3.2 **Analyze and interpret data** from observations and measurements of an object's motion to identify patterns in its motion that can be used to predict future motion. Examples of motion with a predictable pattern could include a child swinging on a swing or a ball rolling down a ramp. (PS2.A, PS2.C)

As you read this section, think about how you can use your observations of patterns in an object's motion to predict how it will move in the future.

Motion

Adapted from *Hummingbird* by Indiana Ivy Nature Photographer, https://flic.kr/p/c1ZXcL, CC-BY

The wings of this hummingbird are moving so fast that they're just a blur of motion. You can probably think of many other examples of things in motion. If you can't, just look around you. It's likely that you'll see something moving, and if nothing else, your eyes will be moving. So you know from experience what motion is. It seems like a simple concept. However, when you read this section, you'll find out that it's not quite as simple as it seems.

In science, motion is defined as a change in position. An object's position is its location. Besides the wings of the hummingbird in the opening image, you can see other examples of motion in the pictures. In each case, the position of something is changing.

Image from
https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/9.1/primary/lesson/motion-ms-ps/?referrer=special

Patterns of Motion

Take a look around you. You can probably observe many different types of objects moving. Maybe you see the hands on the clock, a classmate tapping her foot or a fly buzzing around your classroom. Some of this motion may seem random, but on a closer look, predictable patterns can be observed.

Motion can be described in terms of speed and direction. Speed relates to how fast or slow something is moving. Direction refers to the path that an object takes. Some objects follow a straight line or path. An example of this could be an acorn dropping from an oak tree, or a bowling ball sliding down the lane. Other objects move in a zigzag motion or back and forth, such as a child on a swing. Other objects can move in a rotational, or circular pattern, for example a merry go round or the hands on a clock. Finally, other objects move in an irregular pattern, such as a bee flying around a garden of flowers. If you can identify a pattern of motion, then you can predict how an object will move in the future.

Putting It Together

Image by Arek Socha, pixabay.com, CC0

When a pebble is dropped in water, circular rings form.

What causes this pattern to form?

3.3 Gravity (3.3.3)

Explore this Phenomenon

Sledding in Danehy Park by EandJsFilmCrew, https://flic.kr/p/7sUP6b, CC-BY-ND

At a park, you see a child on a sled coming down a steep hill.

What is causing this to happen?

3.3.3 Gravity

3.3.3 **Construct an explanation** that the gravitational force exerted by Earth causes objects to be directed downward, toward the center of the spherical Earth. Emphasize that “downward” is a local description depending on one’s position on Earth. (PS2.B)

As you read the following section, think about examples of how gravity causes objects to be pulled downward.

Gravity

Why is jumping on a trampoline 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.

"Trampoline" by guinness_duck, https://search.creativecommons.org/photos/2509aee5-550d-4e44-a8b7-5108cc32187d, *CC-BY-NC-SA 2.0*

Gravity is a force, but not like other forces you may know. Gravity is a bit special. You know that a force is a push or pull. If you push a ball, it starts to roll. If you lift a book, it moves upward. Now, imagine you drop a ball. It falls to the ground. Can you see the force pulling it down? That is what makes gravity really cool. It is invisible.

Earth's Gravity

You are already very familiar with Earth's gravity. It constantly pulls you toward Earth's center. What might happen if there was no gravity? You could fly off into space. Gravity keeps us firmly down on the ground. Gravity also pulls on objects that are in the sky. When you throw a ball up, gravity pulls it back down. Gravity also pulls a skydiver back down to Earth. Earth's gravity can even pull objects like meteors from space.

How Can Gravity Be Overcome?

"What goes up must come down." You have probably heard that statement before. At one time this statement was true, but no longer. Since the 1960s, we have sent many spacecraft into space. Some are still traveling away from Earth. So it is possible to overcome Earth's gravity.

Image from WikiImages, pixabay.com, CC0

Do you need a giant rocket to overcome gravity? No, you actually overcome gravity every day. Think about when you climb a set of stairs. When you do, you are overcoming gravity. What if you jump on a trampoline? You are overcoming gravity for a few seconds. Everyone can overcome gravity. You just need to apply a force larger than gravity. Think about that the next time you jump into the air. You are overcoming gravity for a brief second. Enjoy it while it lasts. Eventually, gravity will pull you back down.

Putting It Together

Sledding in Danehy Park by EandJsFilmCrew, https://flic.kr/p/7sUP6b, CC-BY-ND

At a park, you see a child on a sled coming down a steep hill.

Using what you learned in this section, explain what causes the child on a sled to come down the steep hill.

Draw a model to illustrate your explanation.

3.4 Noncontact Forces (3.3.4)

Explore this Phenomenon

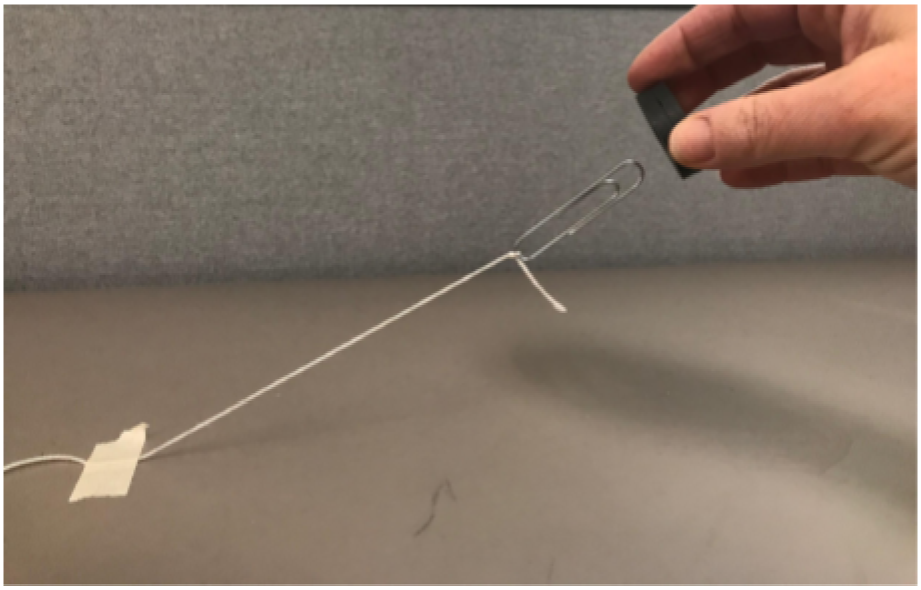


Image by Megan Black, CC0

When a magnet is brought close to a paperclip, the paper clip moves.

What do you notice about the relationship between the paper clip and magnet?

What questions do you have about this phenomenon?

3.3.4 Noncontact Forces

3.3.4 **Ask questions** to **plan and carry out an investigation** to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Emphasize how static electricity and magnets can cause objects to move without touching. Examples could include the force an electrically charged balloon has on hair, how magnet orientation affects the direction of a force, or how distance between objects affects the strength of a force. Electrical charges and magnetic fields will be taught in Grades 6 through 8. (PS2.B)

In this section, think about about forces that can cause objects to move without being in contact.

Non-Contact Forces

In section 3.3.1 you learned about balanced and unbalanced forces. Another way to classify forces are contact and non-contact forces. A contact force occurs when someone or something touches an object to cause motion. Other forces, including gravity, electric and magnetic forces can cause an object to move without touching it. These forces are called non-contact forces.

Take a look at the train in the picture. It looks very futuristic. What do you notice about it? Did you notice that the train has no wheels? How can a train have no wheels? It doesn't need wheels. It actually floats, or levitates, just above the track. Magnets enable the train to do this. This is not a normal train. This is a maglev train. The word "maglev" stands for "magnetic levitation." Because it has no wheels, there is no friction. Some magnets hold the train up. Other magnets are used to move the train forward. This train can go very fast. It can reach speeds up to 480 kilometers (300 miles) per hour! Magnets are pretty cool.

Maglev by Max Talbot-Minkin, https://flic.kr/p/boZ5CA, CC-BY

Properties of Magnets

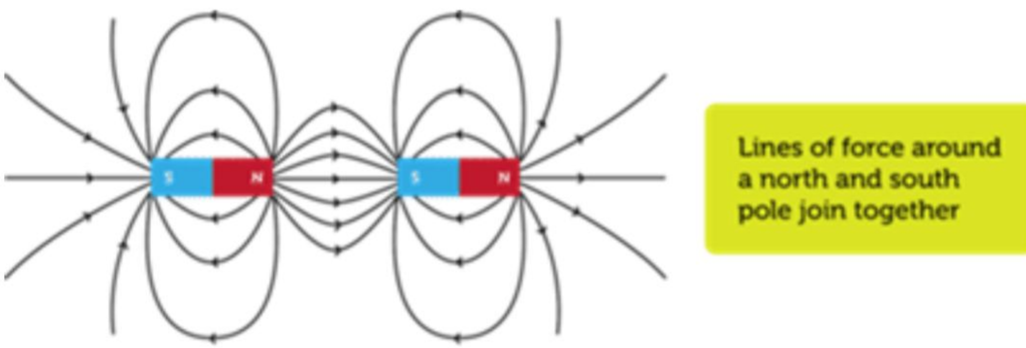
A magnet is an object that can attract other objects. Magnets only attract certain types of objects. They can attract objects that contain iron, nickel, or cobalt. Paper clips are made with iron and are attracted to magnets. Magnets do not attract every type of metal. Aluminum or copper are not attracted to magnets. Another property of magnets is that they have magnetic poles. The poles are called north and south.

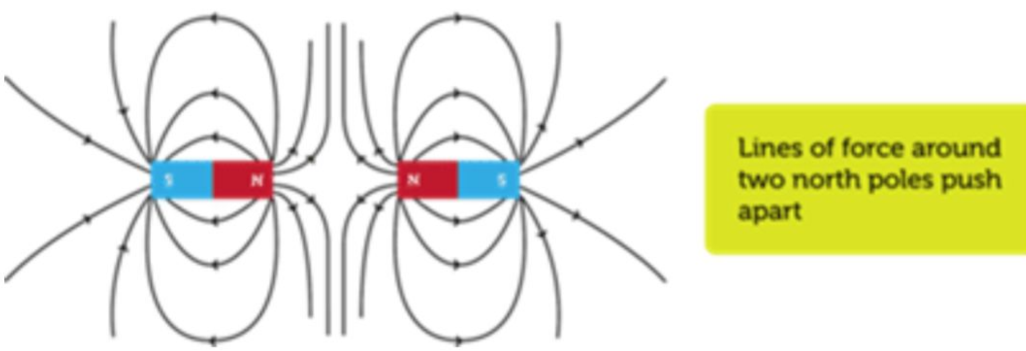
Magnetic Force

You learned earlier that forces are required to move objects. Some forces require objects to touch. For example, you push a book across a table. You are touching the book as it moves.

Magnets can also make objects move. They can produce motion just like you do. Unlike you, magnets do not need to touch the other object to move it. For example, when you bring a magnet towards a pile of staples, the staples will move across the table and stick to the magnet. That's right, a magnetic force does not require objects to touch. A magnet can push or pull certain items without ever touching them. Magnetic force is a non-contact force.

What happens when two magnets are next to each other? You know a force will be present. What type of motion do you think will occur? Will it be a push or a pull? It all depends on how the poles align. North and south poles of two magnets attract each other. This means they pull towards each other. Two north poles or two south poles repel each other. This means that they push against each other.





Electric Force

Electric forces can also move objects without touching them. For example, when you rub a balloon on your sweater, electric charges build up on the balloon. If you bring the balloon close to a friend's head his hair will move and stand up. This is an example of static electricity. Static electricity creates a force that can cause objects to attract or repel each other. The objects do not even have to touch.

IMG_1817 by James Crowley, https://flic.kr/p/3xMG3, CC-BY-NC

Do you remember another force that can move objects without touching? Yes, gravity! Anytime you have a force that can move an object without touching it is called a non-contact force. Magnetic forces, electric forces and gravity can all cause changes in motion without touching.

Putting It Together

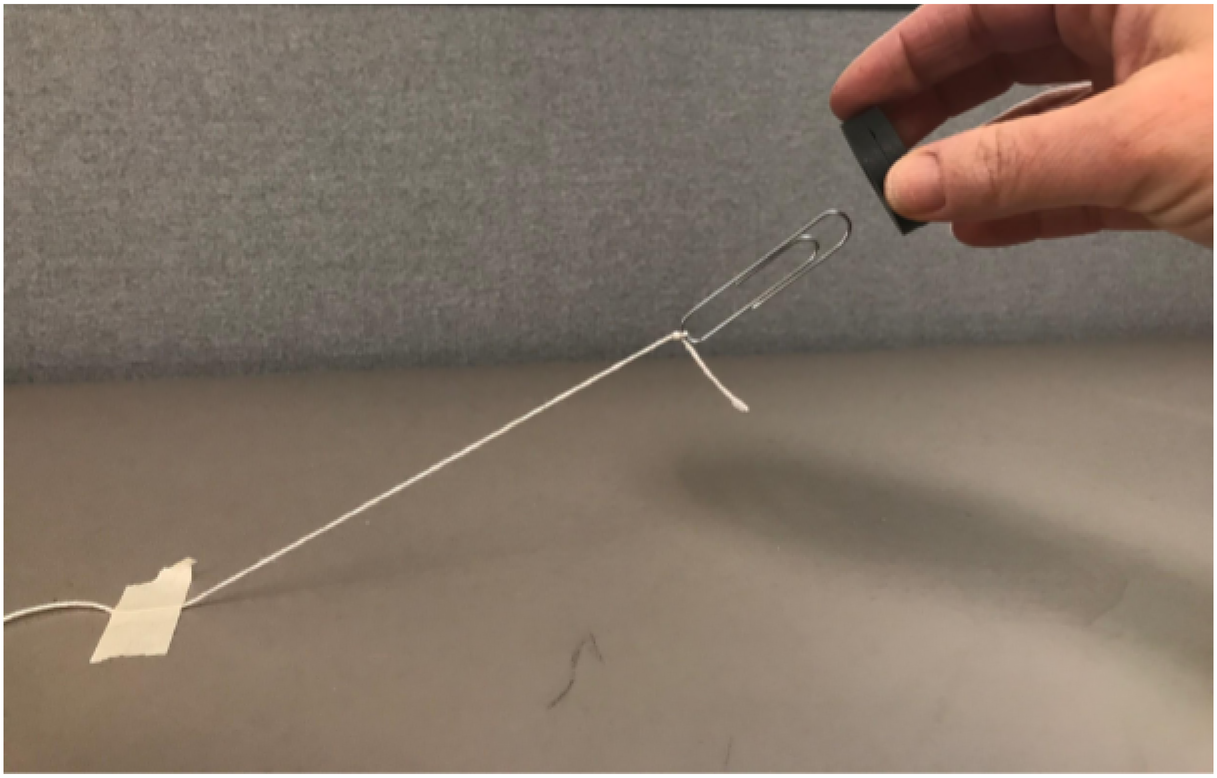


Image by Megan Black, CC0

When a magnet is brought close to a paperclip, the paper clip moves.

Using what you learned in this section, explain what causes the paperclip to move.

Draw a model to help illustrate your explanation.

3.5 Magnetic Devices (3.3.5)

Explore this Problem

Someone tried to fix a broken zipper on a suitcase by using duct tape. The duct tape keeps some of the bag closed, but there are still parts that are open.

Describe a way to keep the entire suitcase closed.

3.3.5 Magnetic Devices

3.3.5 **Design a solution** to a problem in which a device functions by using scientific ideas about magnets. *Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution*. Examples could include a latch or lock used to keep a door shut or a device to keep two moving objects from touching each other. (PS2.B, ETS1.A, ETS1.B, ETS1.C)

As you read this section think about how each example functions by using scientific ideas about magnets.

Uses for Magnets

Engineers solve problems. They solve problems by making things better or fixing things. Some engineers work on solutions for systems. They work to improve processes. Engineers use ideas about science to help them solve problems. Ideas about magnets and magnetic forces can be used by engineers to solve problems. A magnet is a common device that can be used in many different ways to solve simple and complex problems.

If you look around your classroom and or your home you will see magnets used in many places. For example, magnets can hold things together such as a clip to keep a bag of chips closed, or used to hold up papers on a whiteboard. Magnets help keep your refrigerator doors closed. Magnets in the door are attracted to magnets in the refrigerator. This keeps the doors closed without a latch. In your classroom you may have cabinets that stay closed with magnets also.

"New Bag Clips" by iChris, https://search.creativecommons.org/photos/d77b1645-dd06-4688-a678-61174adb244a, CC-BY-NC-SA 2.0

Another way magnets are used is to slow down cars on roller coasters. The roller coaster car has a strong magnet in it. There is another strong magnet at the end of the track. If the magnets are arranged with the same poles facing one another, the magnets will repel. The car and the end of the track will push away from each other. This force prevents the car from crashing into the end of the roller coaster track. Look at the picture of the rollercoaster. Where are the magnets located? How do these magnets help make the ride safe?


Image by V Petkov (TheFreak1337), pixabay.com, CC0

Putting It Together

airport mishap by Lori Greig, https://flic.kr/p/a6UnD2, CC-BY-NC-ND

Someone tried to fix a broken zipper on a suitcase by using duct tape. The duct tape keeps some of the bag closed, but there are still parts that are open.

What are some solutions that you can think of to solve this problem by using what you learned about magnets? Write them down.

Draw a model of your best solution. Explain why it is the best solution for your problem.


Utah State Board of Education