

# 2nd Grade Science

for Utah SEEd Standards  
2020-2021

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for Utah SEEd Standards

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Utah State Board of Education OER  
2020-2021

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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

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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?

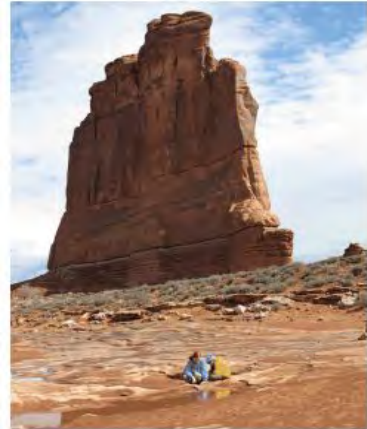
Often when we ask people to imagine this, they draw or describe people with lab coats, people with crazy hair, beakers and flasks of weird looking liquids that are bubbling and frothing. Maybe there's even an explosion. Let's be honest: Some scientists do look like this, or they look like other stereotypes: 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

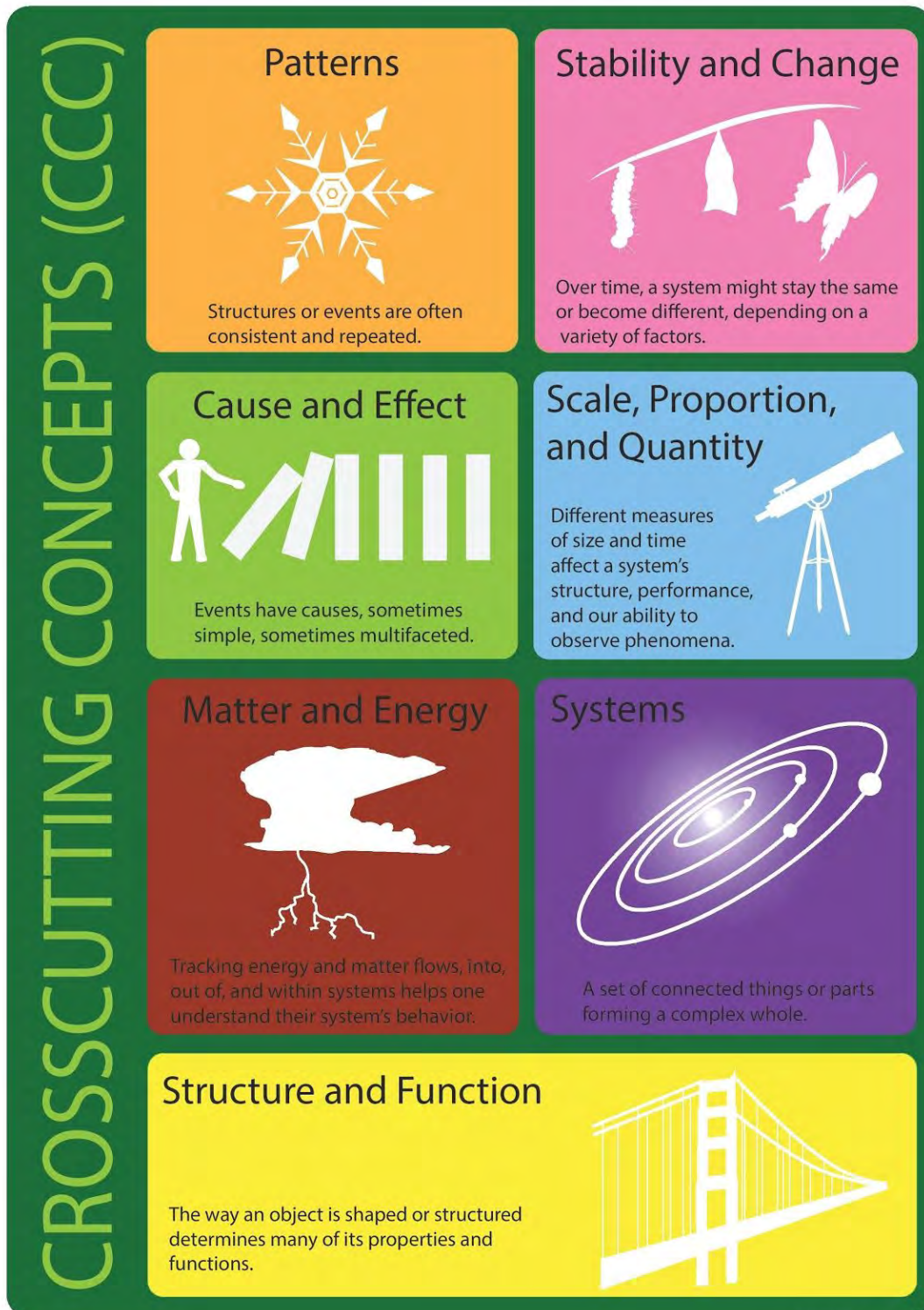
Science and Engineering Practices are what scientists do to investigate and explore natural phenomena





# Cross Cutting Concepts

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



Created by Susan Larson



# A Note to Teachers

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This Open Educational Resource (OER) textbook has been written specifically for students as a reputable source for them to obtain information aligned to the 2nd 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

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## Strand 1: Changes in the Earth's Surface

### Chapter Outline

- 1.1 Landforms (2.1.1)
- 1.2 Slow and Fast Changes (2.1.2)
- 1.3 Prevention (2.1.3)



*Image by Ian D. Keating, <https://flic.kr/p/TzJSLf>, CC-BY*

### Strand 2.1: CHANGES IN THE EARTH'S SURFACE

Earth has an ancient history of slow and gradual surface changes, punctuated with quick but powerful geologic events like volcanic eruptions, flooding, and earthquakes. Water and wind play a significant role in changing Earth's surface. The effects of wind and water can cause both slow and quick changes to the surface of the Earth. Scientists and engineers design solutions to slow or prevent wind or water from changing the land.



# 1.1 Landforms (2.1.1)

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## Explore this Phenomenon



*Image by Bernard Spragg, <https://flic.kr/p/okMSeD>, public domain*

You may see land and water outside.

1. Where do you see land?
2. Where do you see water?

As you read the following section think of how you could create a model of the patterns you observed to show mountains, valleys, canyons, and floodplains

## 2.1.1 Landforms

---

### Standard 2.1.1

**Develop and use models** illustrating the patterns of landforms and water on Earth. Examples of models could include valleys, canyons, or floodplains and could depict water in the solid or liquid state. (ESS2.B)



In this chapter, think about how you could create a model of the patterns in land and water to show mountains, valleys, canyons, and floodplains.

## Patterns in Location of Landforms

### Earth

Earth is the place where all people live. If you look at Earth from space you can see water and land. What colors is the water? What colors is the land?



*Earth*

Image by Joey Littlemore, <https://i1c.kr/p/gsCrmi>, public domain

## Landforms

Land and water cover the surface of Earth. The ground under your feet is part of the land. Earth's surface has many features such as mountains, valleys, canyons, and floodplains. These features on Earth's surface are called landforms. These landforms can also be found at the bottom of lakes and oceans.

Look at the pictures of the landforms. How are the landforms similar? How are the landforms different? What patterns do you see in the landforms? Is water near the landforms?



*Bonneville Shore Trail*

Image by Robb Hannawacker, <https://flic.kr/p/L3ZiCW>, CC-BY-NC-SA





### *Looking Down Into a Valley*

*Image by Bureau of Land Management, <https://flic.kr/p/UuUwcP>, public domain*



### *Grand Canyon*

*Image by Terry Kearney, <https://flic.kr/p/jE8Wg4>, public domain*



### Floodplain- Utah

*Internet Archive Book, <https://flic.kr/p/wPpCgh>, no known copyright restrictions*

Have you ever noticed landforms where you live?

Do you live on a hill or mountain that is part of a mountain range?

Do you live in a valley?

What landforms do you see if you take a trip a few hours away?

### **Creation of Landforms**

Land can be pushed up to form mountains. Earthquakes can cause landforms to crack and break. Water can fall on the land in the form of rain or snow. When water lands on mountains and hills, it drains down forming canyons and rivers. The rivers move the water to lakes and oceans. We see lakes and oceans in valleys or floodplains at the bottom of landforms.

Why don't we see lakes or oceans on the tops of mountains or hills?

## Putting It Together

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*Image by Bernard Spragg, <https://flic.kr/p/okMSeD>, public domain*

Let us revisit this phenomenon: Outside you may see land and water.

1. What are examples of landforms in this picture?
2. Where is water located near the landforms? How did the water get there?
3. Develop a model to show the patterns of landforms and water on Earth.



## 1.2 Slow and Fast Changes (2.1.2)

---

### Explore this Phenomenon



#### *The Goosenecks*

Image by Over Doz, <https://flic.kr/p/zYmUxP>, CC-BY-NC



#### *Landslide*

Image by Bridger Teton NF, <https://flic.kr/p/Vt9uAD>, public domain

In these pictures, Earth's surface has changed.

1. How do you think Earth's surface has changed?
2. Do you think the changes happened slowly or quickly?

## 2.1.2 Slow and Fast Changes

---

### Standard 2.1.2

**Construct an explanation** about changes in Earth's surface that happen quickly or slowly. Emphasize the contrast between fast and slow changes. Examples of fast changes could include volcanic eruptions, earthquakes, or landslides. Examples of slow changes could include the erosion of mountains or the shaping of canyons. (ESS1.C)



In this chapter, see if you can identify changes that happen quickly or slowly on Earth's surface. Think about how fast changes and slow changes are similar and different.

## Changing Earth

Earth's surface is always changing. The changes can be slow or fast. They can affect the Earth's surface in very different ways. The changes can break down landforms or build it up to create new landforms.

### Slow Changes

During slow changes, landforms made of rocks can be broken down into smaller pieces of rocks by wind, water, or ice. The process where bigger rocks are broken down into smaller pieces by wind, water, or ice is called erosion. Erosion slowly causes the landforms to get smaller. Rocks can be moved to a different place by wind, water, or ice. After they are moved they begin to build a new landform somewhere else.



## Ice and wind weathering- Bryce National Park

Image by Bernard Spraggs, <https://flic.kr/p/QAvozd>, Public Domain



## Water Erosion

Image by US National Archives, <https://flic.kr/p/bLmJNH>, no known copyright restrictions

How are landforms changed by slow changes to Earth's surface?



## Fast Changes

Earth's surface can change very fast. Volcanoes can erupt and lava can create new landforms. An earthquake is the shaking of Earth's surface. This is caused by pressure from under the surface. Earthquakes create new landforms. When land moves quickly from high to low ground it is called a landslide. Landslides can happen when there is too much water in the soil or when there are not enough plants to hold the earth materials in place. Landslides create new landforms.



**Recent lava flow**

Image by Gary Todd, <https://i.flic.kr/p/h4Sww3>, Public domain



**Evidence of earthquake**

Image by The U.S. National Archives, <https://i.flic.kr/p/b8pSpk>, no known copyright restrictions



**Landslide**

Image by U.S. Geological Survey, <https://i.flic.kr/p/oLgzgM>, public domain

How are landforms changed by fast changes to Earth's surface?

## Putting It Together

---



### *The Goosenecks*

Image by Over Doz, <https://flic.kr/p/zYmUxP>, CC-BY-NC



### *Landslide*

Image by Bridger Teton NF, <https://flic.kr/p/Vt9uAD>, public domain

Let us revisit the phenomenon:  
In these pictures, Earth's surface has changed.

1. Explain how Earth's surface has changed in each picture.
2. Explain which picture shows Earth's surface after a fast change and which picture shows Earth's surface after a slow change.
3. How do you think Earth's surface in these pictures will continue to change over time?

## 1.3 Prevention (2.1.3)

---

### Engineering Problem



Cliff Eroding

<https://pixabay.com/photos/crooklets-beach-cornwall-bude-1313636/>

People live on top of the cliffs. The wind and water are eroding the cliffs.

1. How could you design a solution to prevent the wind and water from changing the shape of the cliffs?



## 2.1.3 Prevention

---

### **Standard 2.1.3**

**Design solutions** to slow or prevent wind or water from changing the shape of land. **Define the problem** by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs. Examples of solutions could include retaining walls, dikes, windbreaks, shrubs, trees, and grass to hold back wind, water, and land. (ESS2.A, ESS2.C, ETS1.A, ETS1.B, ETS1.C)



In this chapter, think of ways in which you could design a solution to the problem of erosion caused by wind and water.

### **Erosion Prevention**

When it rains, water hits the ground. It can go into the soil to water plants. Water will also drain into streams and rivers and move to lakes and oceans. When it drains it picks up and takes little pieces of landforms and rocks with it. This is called erosion.

If there is a big storm, too much water can run off. This water can take too much soil and land with it. This is a problem because we need soil for gardens, farms, and healthy habitats for animals.

People can slow down or stop the movement of land by covering it with different materials. Plants can grow in soil and their roots hold the land in place. People can also build dams or walls to slow down or stop the movement of land or changes to landforms.



Tell about a problem you know of that occurred because wind or water changed the shape of the land.

As you read the following information, think about possible ways to solve the problem you identified.

What do you know about the land beneath your feet? The land is made of rocks and soil. Soil is the upper most layer of Earth's surface. The soil is where we grow our food. Did you know it is in danger?



**Soil Blown by Wind**

Image by USDA, [https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/about/history/?cid=nrcs143\\_021392](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/about/history/?cid=nrcs143_021392), public domain

Every year farmers lose many tons of soil from their fields. The soil is very important for them to grow their crops. Without good crops, we will have less food. How can we prevent soil loss?

Soil is lost in two ways. Water can erode, or move, the soil when it rains. The wind can pick up loose and dry soil and erode it. Water and wind are like thieves when it comes to soil. They both can carry it away.



**Wind Erodes Soil**

*Image by Sydney Oats, <https://flic.kr/p/7FdcWU>, CC-BY*

Wind and water play a major role in erosion. We know that soil is gained and lost from areas. We know it needs to be protected. Scientists and engineers want to learn about ways to prevent erosion.

Scientists and engineers study rivers to learn about erosion. They also want to find ways to prevent it. They have built special structures to keep soil from eroding.



**Water Erodes Soil**

*Image by Stephen Gore, <https://flic.kr/p/arFUN>, CC-BY*

How does a large rock wall or sandbags prevent erosion?



### Retaining Wall

Image by Washington State Department of Transportation, <https://flic.kr/p/7rGbK7>, CC-BY-NC-ND



### Sandbags

Image by Jesse Thorstad, <https://flic.kr/p/69YB63>, CC-BY-NC-ND



Image by kansaaphoto, <https://lic.kr/p/5Qtnb6>, CC-BY

Wind too can steal soil from other areas. Some areas benefit from this new soil. The red soils of Bermuda were stolen by the wind. They were once the soil of Africa. The fertile soils of Illinois were brought in on the wind. They blew up from the Mississippi River valley after the last ice age.

For a farmer, losing soil is not good. Farmers can lose their thick soil. What is left is soil not suited for growing crops. This is why we must be careful. Scientists and engineers study soil loss and work on ways to prevent it.

Can you think of some ways?

Soil needs plants to protect it. Plant roots help hold it in place. Farmers now leave some vegetation in their fields. They do not want to lose their soil. Planting trees along fields can block the





*Farmer and Orchard*

Image by Northern Lights 119, <https://iic.kr/p/c/z9wQ>, CC-BY-NC-ND

wind. By slowing the wind, it prevents the soil from blowing away. How can we protect the soil from water erosion?

Plants also protect soil from water erosion. The plants help the soil stay in place. They protect the soil from the impact of rain. Steep slopes increase water erosion.

Some farmers use special techniques to keep their fields level. Level fields are in much less danger from erosion.



**Level Farm Fields**

Image by Tim McCabe, USDA Natural Resource Conservation Service, <https://iic.kr/p/eK5i55>, CC BY-NC

What are some ways you can prevent erosion at your home?

## Putting It Together

---



Cliff Eroding  
Image by iexpresdimages, pixabay.com, CC0

Let us revisit the problem:  
People live on top of the cliffs.  
The wind and water are eroding the cliffs.

Tell about a problem you know  
of that occurred because wind  
or water changed the shape of  
the land.

### **Define the problem:**

What problem did you identify that happens because wind or water changes the shape of the land.

### **Gathering Information:**

When does the land move?

What evidence can you find of land movement and change?

### **Designing a Solution:**

What are some possible solutions to fix the problem?

Which solution will best reduce the changes to the shape of the land? Why?

Draw a picture of your design for slowing or stopping the movement of land.

# CHAPTER 2

## Strand 2: Living Things and Their Habitats

### Chapter Outline

- 2.1 Different Habitats (2.2.1)
- 2.2 Structure and Function (2.2.2)
- 2.3 Seed Dispersal (2.2.3)
- 2.4 Mimicking Animals (2.2.4)



*Fish in Ocean Habitat*  
Image by visavietnam, pixabay.com, CC0

### Strand 2.2: LIVING THINGS AND THEIR HABITATS

Living things (plants and animals, including humans) need water, air, and resources from the land to survive and live in habitats that provide these necessities. The physical characteristics of plants and animals reflect the habitat in which they live. Animals also have modified behaviors that help them survive, grow, and meet their needs. Humans sometimes mimic plant and animal adaptations to survive in their environment.

## 2.1 Different Habitats (2.2.1)

---

### Explore this Phenomenon



**Black Tailed Jackrabbit**  
Image by Utah Division of Wildlife Resources,  
<https://wildlife.utah.gov/hares-rabbits.html>, public domain



**Arctic Rabbit**  
Image from pixabay.com,  
<https://pixabay.com/photos/arctic-rabbit-canada-wildlife-2406055/>, CC0

There are pictures of two rabbits. They are both rabbits, but they do not look exactly alike.

1. What patterns in their features do they have in common?
2. What is different about the patterns in their features?
3. Do you think that they live in the same place?
4. Do you think that they live in different places?
5. What type of place do you think each rabbit lives in?



## 2.2.1 Different Habitats

---

### **Standard 2.2.1**

**Obtain, evaluate, and communicate information** about patterns of living things (plants and animals, including humans) in different habitats. Emphasize the diversity of living things in land and water habitats. Examples of patterns in habitats could include descriptions of temperature or precipitation and the types of plants and animals found in land habitats. (LS2.C, LS4.C, LS4.D)



In this chapter, you will read about different plants and animals that live in different habitats. Look for the patterns in the structures of the living things that survive in the same habitat.

## **Habitats**

Habitats are the areas where living things, plants and animals, including humans, survive. There are many different kinds of habitats from the tops of the mountains to the bottoms of oceans. Plants and animals live in habitats that provide the necessary resources they need to survive, like water, air, food, shelter, or space. Plants and animals grow better in habitats that meet their needs.

### **Habitats are Different From Each Other**

There are many different kinds of habitats, like a forest habitat, aquatic habitat, or tundra habitats. Each habitat has unique weather and living things.



Map of Great Basin Desert in North America  
Image by MojaveNC, public domain

A desert is a type of habitat. The Great Basin Desert is one example of a desert in the United States of America.

Next is a graph of the average monthly temperatures over one year in the Great Basin Desert.

Temperature measures how hot and how cold the air is in a habitat.

Do the temperatures change or stay the same throughout the year?

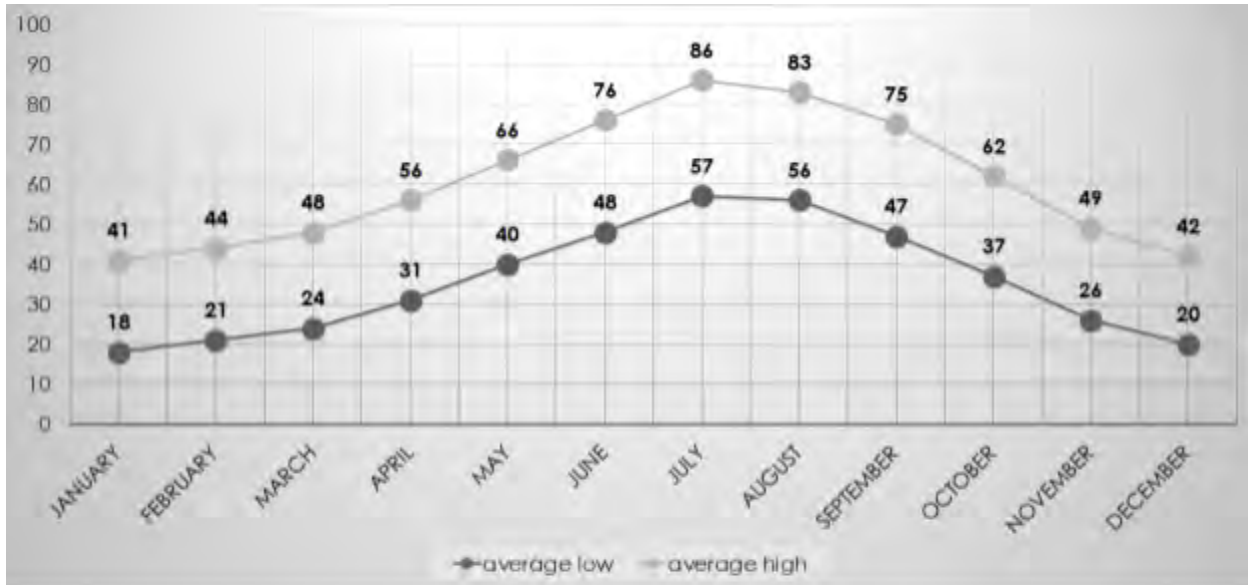
What month has the highest temperature?

What month has the lowest temperature?

Are the lowest and highest temperatures very similar or different from each other?

In each month, what time of day do the high temperatures happen and what time of day do the low temperatures happen?

Can you describe a pattern you see in the temperature data in the Great Basin Desert?



## Average Monthly Temperature in Degrees Fahrenheit of Great Basin Desert

(data from [https://www.nps.gov/grba/planyourvisit/weather.htm#CP\\_JUMP\\_26601](https://www.nps.gov/grba/planyourvisit/weather.htm#CP_JUMP_26601), public domain)

Next is a graph of the average monthly precipitation over one year in the Great Basin Desert.

Precipitation measures how much water falls as rain or snow on a habitat.

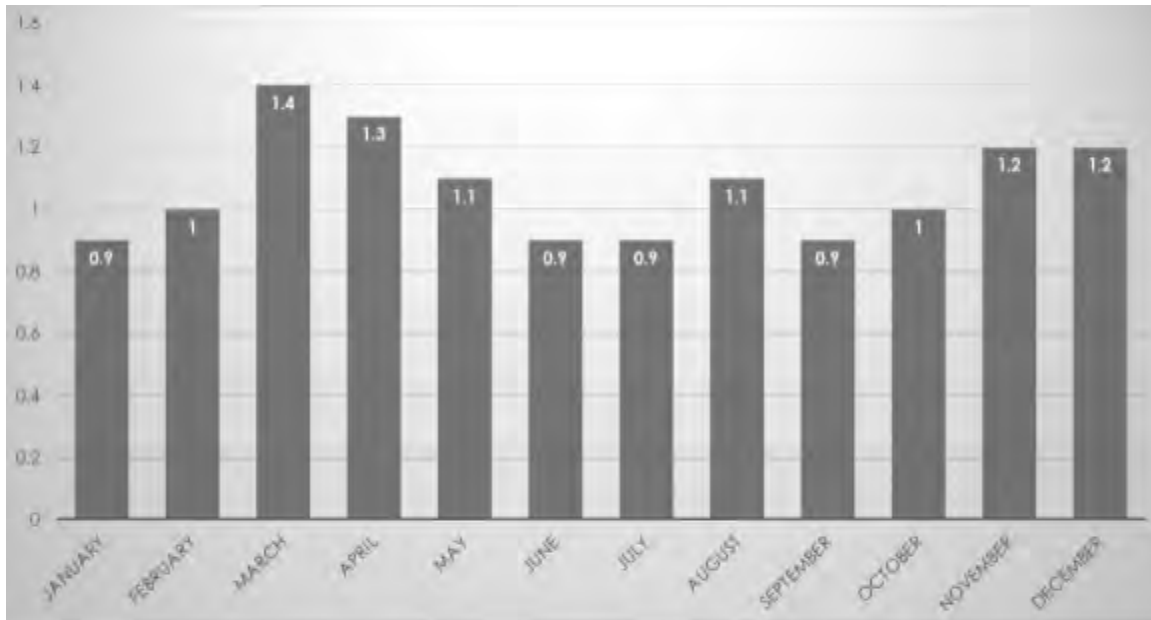
Does the precipitation change or stay the same throughout the year?

What month receives the most precipitation?

What month receives the least precipitation?

Are the lowest and highest amounts of precipitation very similar or different from each other?

Can you describe a pattern you see in the amount of precipitation in the Great Basin Desert?



**Average Monthly Precipitation in Inches of Great Basin Desert**

(data from [https://www.nps.gov/grba/planyourvisit/weather.htm#CP\\_JUMP\\_26601](https://www.nps.gov/grba/planyourvisit/weather.htm#CP_JUMP_26601), public domain )

How do you think the living things that survive in the Great Basin Desert deal with changing temperatures and different amounts of precipitation throughout the year?

Could living things have physical characteristics or behaviors that help them survive in the Great Basin Desert?

## **Animals and Habitats**

There are billions of living things that survive in different habitats on Earth! Depending on the habitat, all of these living things will have physical characteristics that reflect the habitat in which they live.

Look at the pictures of the lizard, kangaroo rat, and cactus that live in a desert. What differences do you see in the physical



characteristics of living things that survive in a desert? What similarities do you see in the physical characteristics of the living things that survive in a desert?



Lizard in Desert Habitat

*Image by LoggaWiggler, <https://pixabay.com/photos/iguana-animal-reptile-desert-fauna-4612/>, CC0*



Kangaroo Rat in Desert Habitat

*Image by US Fish and Wildlife Services, <https://flic.kr/p/bsT65d>, CC-BY*



### Cactus and Sagebrush in Desert Habitat

*Image by Skeeze, pixabay.com, CC0*

Living things that survive in a desert habitat will have physical characteristics that help them find water. Did you see these physical characteristics?

Look at the pictures of the sawfish, seal, and seaweed that live in the ocean. What differences do you see in the physical characteristics of living things that survive in an ocean?

What similarities do you see in the physical characteristics of the living things that survive in an ocean?



**Sawfish in Ocean Habitat**

*Image from PublicDomainImages, pixabay.com, CC0*



**Harbor Seal in Ocean Habitat**

*Image by Tom und Nicki Löschner (ToNic-Pics), pixabay.com, CC0*



**Seaweed in Ocean Habitat**

*Image by Nichole Bohner, pixabay.com, CC0*

Living things that survive in an ocean habitat will have physical characteristics that help them move and breath in water.

Did you see these physical characteristics?



What patterns do you see in the physical characteristics of living things that survive in a forest habitat?



## Living Things in Forest Habitat

*Image by patteybleecker, pixabay.com, CC0*



## Putting It Together

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**Black Tailed Jackrabbit**  
Image by Utah Division of Wildlife Resources,  
<https://wildlife.utah.gov/hares-rabbits.html>, public domain



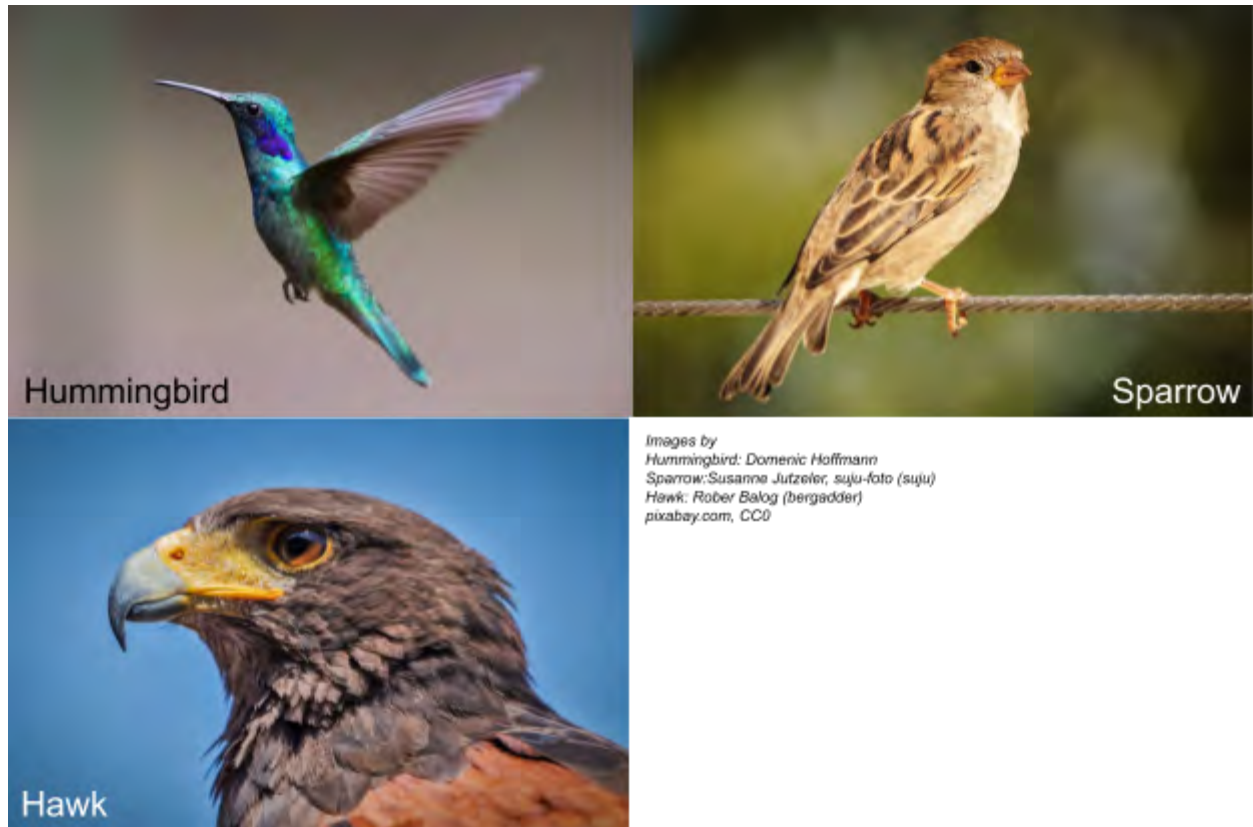
**Arctic Rabbit**  
Image from pixabay.com,  
<https://pixabay.com/photos/arctic-rabbit-canada-wildlife-2406055/>, CC0

Let us revisit the phenomenon: There are pictures of two rabbits. They are both rabbits, but they do not look exactly alike.

1. What similarities do you see in the physical characteristics of the rabbits?
2. What differences do you see in the physical characteristics of the rabbits?
3. Do you think that they live in the same habitat?
4. Do you think that they live in different habitats?
5. What is the habitat of each rabbit?

## 2.2 Structure and Function (2.2.2)

### Explore this Phenomenon



Birds have different beak structures.

1. How is the shape of the bird beaks similar to each other?
2. How is the shape of the bird breaks different from each other?
3. What do birds use their beaks for?

## 2.2.2 Structure and Function

---

### **Standard 2.2.2**

**Plan and carry out an investigation** of the structure and function of plant and animal parts in different habitats. Emphasize how different plants and animals have different structures to survive in their habitat. Examples could include the shallow roots of a cactus in the desert or the seasonal changes in the fur coat of a wolf. (LS1.A, LS4.A, LS4.D)



In this chapter, you will read about the structures of living things. These structures have a function that allows living things to survive in their habitats.

## **The Structures of Living Things**

A habitat is the physical area where plants and animals live. Habitats have everything that living things need to survive. Living things have parts or structures that allow them to survive in their habitats. For example, animals have structures like eyes, shells, or hands. Plants also have structures like roots, leaves, and seeds. These structures have a purpose or function. For example, the function of eyes is to see the habitat or the function of roots is to drink water from the ground. The structure and function work together to allow plants and animals to survive in their habitats.

### **Sea Turtles**

Sea turtles live in the ocean. They need to spend long amounts of time in the water, but also go on land to lay eggs. Their flippers allow them to swim in the ocean and move on land. Sea turtles need to be protected from predators. Their hard shells protect their bodies while in the ocean and on land.

What structures allow sea turtles to survive in their habitat? What is the function of these structures?



Sea Turtle in Ocean  
Image by Free-Photos, pixabay.com, CC0



Sea Turtle on Land  
Image by skyscraper, <https://www.kirjipix.com>, CC-BY

## Cacti

Cacti live in the desert. Deserts do not have a lot of water. Cacti gather water from the ground with long roots and store water in tubes in their trunks for times when it does not rain. Cacti need to protect their stored water. They have spikes on the outside of their structure to defend their water from predators.



Cactuses in Desert  
Image from pixabay.com, CC0

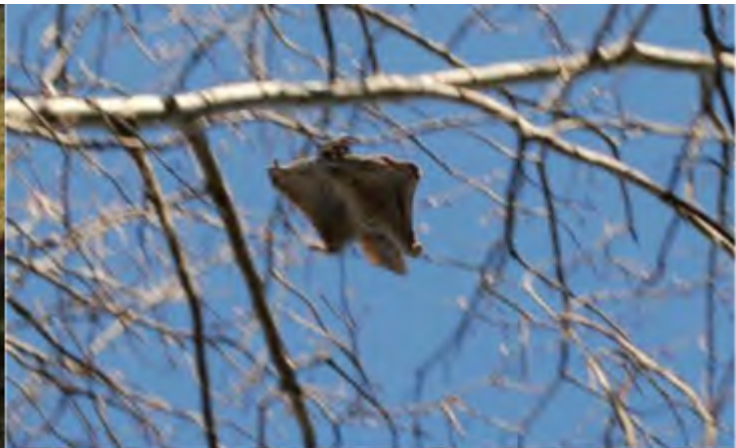
What structures allow cactuses to survive in their habitat? What is the function of these structures?



## Flying Squirrels

Flying squirrels live in the forest. They spend most of their lives in trees without touching the ground. Their hands and feet grip branches. This allows them to climb to get food. Their skin allows them to glide through the air to escape predators and move from tree to tree.

What structures help flying squirrels survive in their habitat? What is the function of these structures?



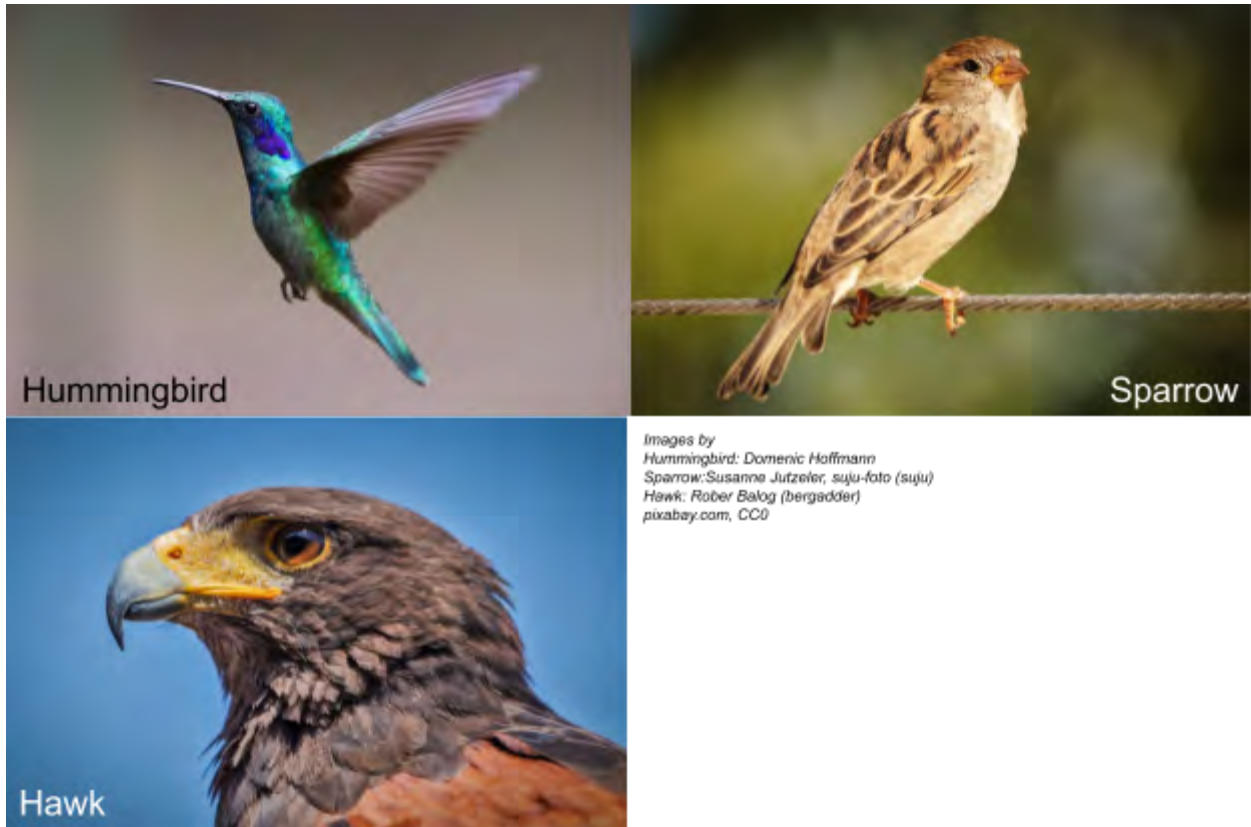
(Top) Flying Squirrel Gliding in Forest

*Image by Angle spuc at English Wikipedia.*  
[https://commons.wikimedia.org/wiki/File:Flying\\_squirrel\\_in\\_a\\_tree.jpg](https://commons.wikimedia.org/wiki/File:Flying_squirrel_in_a_tree.jpg), CC-BY-SA

(Left) Flying Squirrel Climbing in Forest

*Image by US Fish and Wildlife Services.*  
[https://en.wikipedia.org/wiki/New\\_World\\_flying\\_squirrel#/media/File:Glaucomys\\_volans.jpg](https://en.wikipedia.org/wiki/New_World_flying_squirrel#/media/File:Glaucomys_volans.jpg), public domain

## Putting It Together



Let us revisit the phenomenon: Birds have different beak structures.

1. How is the structure of the bird beaks similar to each other?
2. How is the structure of the bird breaks different to each other?
3. What is the function of the bird beaks?
4. How does the structure and function of the bird beaks help birds survive in their habitats?

## 2.3 Seed Dispersal (2.2.3)

---

### Explore this Phenomenon



Burdock Seeds

*Image by liz west, <https://flic.kr/p/4wPKnr>, CC-BY*

Some plants have spiky seeds.

1. Describe the structure of the seeds?
2. What is the function of the structure of the seeds?

## 2.2.3 Seed Dispersal

---

### **Standard 2.2.3**

**Develop and use a model** that mimics the function of an animal dispersing seeds or pollinating plants. Examples could include plants that have seeds with hooks or barbs that attach themselves to animal fur, feathers, or human clothing, or dispersal through the wind, or consumption of fruit and the disposal of the pits or seeds. (LS2.A)



In this chapter, you read about the structure and function of plant parts that allow them to reproduce. Think about how you can develop a model to mimic the function of an animal dispersing seeds.

### **Seed Dispersal**

Plants have many structures that allow them to survive. An important part of survival is reproducing, or making copies of itself. Seeds are a structure of plants with the function of reproducing. Seeds need to be planted in new areas to have space to grow. Because plants cannot change their area, they use animals or wind to help spread their seeds.

### **Animals Disperse Seeds**

Plants create seeds to reproduce. Sometimes plants grow fruits with seeds inside. When the fruits are ripe, they fall to the ground. The seeds grow or animals eat the fruit with the seeds inside.

How does getting eaten by animals help disperse seeds?





Kiwi Fruit with Seeds Inside

*Image by Shutterbug75, pixabay.com, CC0*

Once eaten, the seeds of fruits are passed through the digestive tract of animals. When the animals eliminate their waste, the waste contains the seeds. If the seeds land in an area that has the necessities to survive, they will begin to grow.

In this example, how do plants rely on animals to disperse their seeds?

Some seeds are covered in spikes or hooks. These seeds get stuck on passing animal fur, feathers, or clothing. The seeds are carried to another area when the animals move. Eventually, the seeds fall or



Seeds Covered in Hooks

*Image by Pumuki111, pixabay.com, CC0*

are pulled off the animals. If the seeds land in an area that has the necessities to survive, they will begin to grow.

In this example, how do plants rely on animals to disperse their seeds?

## **Wind Disperses Seeds**

Some seeds have a helicopter rotor blade shaped structure. This structure allows the seeds to travel by wind away from the tree and land in a new area. Other seeds have a lightweight structure. This structure allows the seeds to travel by wind and land in a new area. If the seeds land in an area that has the necessities to survive, they will begin to grow. In these examples, how do plants rely on the wind to disperse their seeds?



Dandelion Seeds



Maple Tree Seeds

Images by (left) Peter Dargatz and (right) Hans Braxmeier, pixabay.com, CC0

## Putting It Together

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Seeds Covered in Hooks

*Image by Pumuki111, pixabay.com, CC0*

Let's revisit the phenomenon: Some plants have spikey seeds.

1. Describe the structure of the seeds?
2. What is the function of the structure of the seeds?
3. Develop a model that mimics the function of animals dispersing these seeds.

## 2.4 Mimicking Animals (2.2.4)

---

### Engineering Design Problem



Untied Sneaker

*Image by Jason Goh (cegoh), pixabay.com, CC0*

It can be difficult to tie a bow in lace of a sneaker.

1. How could you design a solution based on the structure and function of the physical characteristics of living things to prevent the sneaker from falling off without having to tie a bow in the lace of a sneaker?



## 2.2.4 Mimicking Plants and Animals

---

### **Standard 2.2.4**

**Design a solution** to a human problem by mimicking the structure and function of plants and/or animals and how they use their external parts to help them survive, grow, and meet their needs. *Define the problem by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs.* Examples could include a human wearing a jacket to mimic the fur of an animal or a webbed foot to design a better swimming fin. (LS1.A, LS1.D, ETS1.A, ETS1.B, ETS1.C)



In this section, you will read about how engineers develop ideas for objects from the structures and functions of living things. As you read, think of a way you could solve the problem above.

### **Mimicry**

Engineers are people who construct products, buildings, or machines. Engineers must think about the structure and function of their designs. Sometimes their ideas are mimics, or copies, of the structures and functions of their designs come from the external parts of living things.

Engineers mimicked the structure and function of a bird wing to create an airplane wing. How are the structures and functions similar?



**Bird**

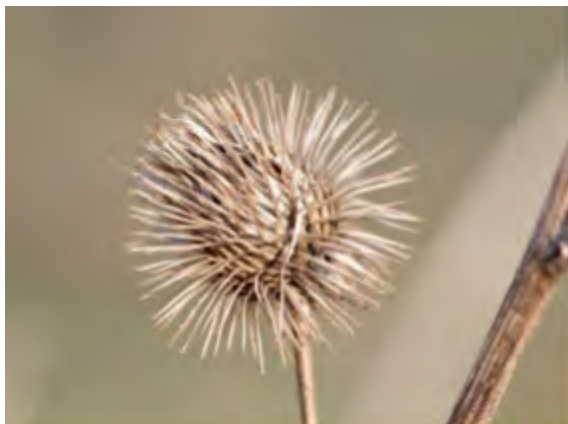
*Image by pralea vasile (vasile\_pralea), pixabay.com, CC0*



**Airplane**

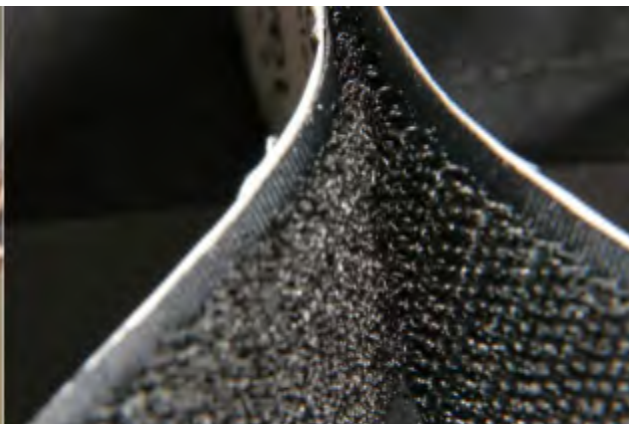
*Image by Skeeze, pixabay.com, CC0*

Engineers mimicked the structure and function of burdock seeds to create Velcro. How are the structures and functions similar?



**Burdock Seed**

*Image by Henryk Niestrój (Arcaion), pixabay.com, CC0*



**Velcro**

*Image by Daniel Linwood, <https://iic.kr/p/v6qXw>, CC-BY-NC-ND*

## Putting It Together

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Untied Sneaker

*Image by Jason Goh (cegoh), pixabay.com, CC0*

**Let us revisit our problem:** It can be difficult to tie a bow in lace of a sneaker.

1. How could you design a solution based on the structure and function of the physical characteristics of living things to prevent the sneaker from falling off without having to tie a bow in the lace of a sneaker?

# CHAPTER 3

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## Strand 3: Properties of Matter

### Chapter Outline

- 3.1 Classifying Properties (2.3.1)
- 3.2 Use and Function (2.3.2)
- 3.3 Parts of a Structure (2.3.3)
- 3.4 Changes in Matter (2.3.4)



Examples of Matter  
Image by Mabel Amber, pixabay.com, CC0

All things are made of matter which exists with different forms and properties. Matter can be described and classified by its observable properties. Materials with certain properties are well-suited for specific uses. Heating or cooling some types of matter may or may not irreversibly change their properties.



## 3.1 Classifying Properties (2.3.1)

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### Explore this Phenomenon



Playground by a Lake

*Image by Maria (Summa), pixabay.com, CC0*

At the park, you see the playground is built of different materials.

1. What kinds of materials were used to build this playground?
2. What are some similarities and differences in the materials used to build the playground?
3. What is one way you group the materials used to build the playground?

## 2.3.1 Classifying Properties

---

### **Standard 2.3.1**

**Plan and carry out an investigation** to classify different kinds of materials based on patterns in their observable properties. Examples could include sorting materials based on similar properties such as strength, color, flexibility, hardness, texture, or whether the materials are solids or liquids. (PS1.A)



In this chapter, see if you can identify different observable properties of materials. Think about how you can use patterns in the observable properties of materials to classify the different kinds of materials.

## **Classifying Materials Based on Patterns**

### **What is Matter?**

Matter is all the stuff that exists in the Universe. Matter is anything that takes up space and has weight. Matter is found in materials used to build a playground. The wood beams that provide support are matter. The metal chains that hold the swings are matter. The sand that softens the ground is matter. What else on the playground is matter?

Water is matter, rocks are matter, and rope is matter. Everything you can see and touch is made of matter, including you.



**Ocean Waves**

*Image by Dimitris Vetsikas (dimitrisvetsikas1969), pixabay.com, CC0*



**Rock Beach**

*Image by Frank Winkler, pixabay.com, CC0*



**Rope**

*Image by Christoph Schütz (schuetz-mediendesign), pixabay.com, CC0*

## Classifying Matter

Classification is a way that we can sort matter based on patterns that we see in the properties, or physical characteristics, of matter. There are many ways to sort matter. Some matter is hard and some matter is soft. Some matter is stiff or difficult to bend and some matter flexible or easy to bend. Matter can be sorted by color, like grass and grasshoppers are green or bricks and dirt are brown. Matter can be sorted by strength. Strong matter is tough to break and weak matter breaks easily. Bumpy or smooth are ways to sort matter by texture. Another way to sort matter is by its form. Matter can be liquid or solid.

## Liquids

Liquids are a form of matter. Liquids move freely and take the shape of their surroundings. Examples of liquids include milk, water, or juice. What other things can you name that are liquids?



Water Droplet

*Image by rony michaud, pixabay.com, CC0*



Orange Juice

*Image by PhotoMIX-Company, pixabay.com, CC0*



Milk

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



## Solids



Wood

*Image by PublicDomainPictures, pixabay.com, CC0*

Solids are a type of matter. Solids are objects that have a specific shape. Examples of solids include wood, metal, and plastic. What other things can you name that are solids?



Metal Gears

*Image by Jarkko Manty, pixabay.com, CC0*



Plastic Blocks

*Image by Steve Bissinne (stevepb), pixabay.com, CC0*

## Putting It Together

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Playground by a Lake

*Image by Maria (Summa), pixabay.com, CC0*

Let us revisit this phenomenon: At the park, you see the playground is built of different materials.

1. Identify the kinds of materials used to build the playground.
2. Classify the materials used to build the playground based on patterns in the observable properties of the materials. Some observable properties that you could use to classify materials are solid, liquid, texture, strength, or flexibility.

## 3.2 Use and Function (2.3.2)

---

### Explore this Phenomenon



*Rope Bridge (top) by Marjon Besteman-Horn  
Suspension Bridge (bottom) by Free-Photos, pixabay.com, CC0*

By looking at these two pictures, you see bridges are built differently.

1. Who uses the bridges in each picture?
2. What uses the bridges in each picture?
3. What materials are used to build the bridges?
4. What are the purposes of the bridges in each picture?

## 2.3.2 Use and Function

---

### **Standard 2.3.2**

**Construct an explanation** showing how the properties of materials influence their intended use and function. Examples could include using wood as a building material because it is lightweight and strong or the use of concrete, steel, or cotton due to their unique properties. (PS1.A)



In this chapter, see if you can identify the observable properties of materials used to build objects. Think about how the structures of materials influence the intended use and function of the objects.

## **Materials have Different Structures, Functions, and Uses**

### **Structure and Function**

Engineers are people who construct products, buildings, or machines. Engineers must think about the structure and function of the material they are using when creating their designs. The structure of the materials is the shape of the material and the observable properties that make the material unique, like strength or weight. The function of the object is its purpose.



Books  
Image by Alexander Trush, pixabay.com, CC0



Concrete Roads  
Image by Pixels, pixabay.com, CC0



## Purpose

The unique properties of materials can help decide their use. Paper is flexible and light, but not strong enough to hold up cars on a bridge. Concrete on a road is strong enough to hold cars but would not be good to make a book.

Some materials can be used in many different ways. For example, metal can be used to create a necklace or it could be used to make a building.



What observable properties in the structure of metal do you think allow it to function in different ways?

**Metal Necklace**

*Image by Ella (Ellaspix), pixabay.com, CC0*



**Metal Building**

*Image by Anja (cocoparisienne), pixabay.com, CC0*

Engineers must decide what kinds of materials will be best for each job. They think about the observable properties of materials to decide how to use them.

What do you think each of these materials might be used to build?  
How could you use observable properties in their structure to help you decide on their function in your design?



**Fabric**

*Image by Skeeze, pixabay.com, CC0*



**Logs**

*Image by Free-Photos, pixabay.com, CC0*



**Pebbles**

*Image by Sara (sarajuggernaut), pixabay.com, CC0*

Look at the picture of the playground again.

What structure allows the swing to move?

What structure allows kids to climb the playground?

What is the function of the wood?

What is the function of the metal chain?

What other materials could be used to build a playground?



**Playground by a Lake**

*Image by Maria (Summa), pixabay.com, CC0*



## Putting It Together



*Rope Bridge (top) by Marjon Besteman-Horn*

*Suspension Bridge (bottom) by Free-Photos, pixabay.com, CC0*

Let us revisit this phenomenon: By looking at these two pictures, you see bridges are built differently.

1. What is similar in the structure of the bridges?
2. What is different in the structure of the bridges?
3. What is similar in the function of the bridges?

4. What is different in the function of the bridges?

5. How do the observable properties of the structure the materials used to build the bridges influence the function of the bridges?



## 3.3 Parts of a Structure (2.3.3)

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### Explore this Phenomenon



**Brick Bridge**

(top left) by Free-Photos, pixabay.com, CC0

**Brick House**

(top right) by djedj, pixabay.com, CC0

**Brick Fireplace**

(bottom left) by Rebecca Varney (RVarney), pixabay.com, CC0

These objects are made of the same material and yet they have different functions.

1. What is the material these objects are made from?
2. How can different objects use the same materials and have different functions?

## 2.3.3 Parts of a Structure

---

### **Standard 2.3.3**

**Develop and use a model** to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks. (PS1.A)



In this chapter, think about how there are many objects made from the same materials. Think about how you could create a model to show how the pieces of one object could be taken apart and put back together to make a new object with a different function.

## Function of Structures

### **Different Objects with the Same Materials**

Objects are made of parts and pieces. In the phenomenon above, the same material was used to build a bridge, a house, and a fireplace. What is unique about the structure of bricks that allow engineers to use them to build many objects?

Each object that was built with bricks has a different function. The bridge makes it possible for cars to cross the river. The house provides shelter for a family. The fireplace is a place for people to cook and to get warm. Even though they are made of the same material each object has a different function.

The bricks in each object could be taken apart and used to make a new object. Look at these pictures and see how the function

changed when the structure changed. Many different objects can be constructed with the same set of pieces.



Child Building with Blocks

Image by svklimkin (klimkin), pixabay.com, CC0



Playground by a Lake

Image by Maria (Summa), pixabay.com, CC0

Look at the picture of the playground again.

What small pieces make up the playground?

How could these small pieces be disassembled and reshaped

to make a new object with a different function?

## Putting It Together

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### Brick Bridge

(top left) by Free-Photos, pixabay.com, CC0

### Brick House

(top right) by djedj, pixabay.com, CC0



### Brick Fireplace

(bottom left) by Rebecca Varney (RVarney), pixabay.com, CC0

Let us revisit the phenomenon: These objects are made of the same material and yet they have different functions.

1. Develop and use a model to describe how a small set of pieces can be reshaped to create a new object with a different function.



## 3.4 Changes in Matter (2.3.4)

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### Explore this Phenomenon



Ice on a Lake

Image by Matthias Groeneveld, pixabay.com, CC0



Forest Burning

Image by USFS Region 5, <https://iic.kr/p/cFqae>, CC BY-NC 3.0

Matter can change form.

1. What are some ways that matter changes?
2. Can matter change back to its beginning form once its been changed?

## 2.3.4 Changes in Matter

### **Standard 2.3.4**

**Obtain, evaluate, and communicate information** about changes in matter caused by heating or cooling. Emphasize that some changes can be reversed and some cannot. Examples of reversible changes could include freezing water or melting crayons. Examples of irreversible changes could include cooking an egg or burning wood. (PS1.B)



In this chapter, see if you can obtain information about what causes changes to matter. Identify changes to matter that are reversible and changes that are irreversible.

## Changes in Matter

### Matter Changes Form



Freezing Water

Image by M. Maggs (WildOne), pixabay.com, CC0

Water is normally a liquid at room temperature. It turns to a solid when the temperature gets colder. Ice is solid water. Ice forms when the temperature is zero degrees Celsius. We call this change freezing. You may see lakes freeze. Where else might water freeze?

Water can turn from solid ice back into liquid water. It goes through this change when the temperature warms up above zero degrees Celsius. If matter can

be changed back to the form it started in, the change is called reversible.



**Melting Ice**

*Image by Arek Socha (qimono), pixabay.com, CC0*

In many areas, scientists burn areas of forest. Fire brings change. Are forest fires bad?

Fire can benefit the forest. Dead trees get burned. This leaves room for new growth. New trees and plants grow where older trees once were. The new growth provides food for the animals. In some ways, fire gives a forest new life.



**New Forest Growth**

*Image by Free-Photos, pixabay.com, CC0*

## Permanent or Irreversible Changes

Trees that are burned do not come back to life. For the burned trees, the change is permanent. When trees are burned, they are turned to ash. The ash cannot be turned back into a tree. When matter cannot be changed back into the form it started in, the change is called irreversible. For the forest, the change can be positive. Changes can be permanent or not permanent. That does not mean either one is good or bad.

Change is all around us. Change brings new things. Some changes are reversible. Some changes are irreversible. Can you name some changes? Are they reversible or irreversible?



Playground by a Lake

Image by Maria (Summa), pixabay.com, CC0

Look at the picture of the playground again.

What type of changes would happen to the matter in this playground if it were exposed to fire?

Would these changes be reversible or irreversible?

What type of changes would happen to the matter in this playground when it gets cold outside and water freezes?  
Would these changes be reversible or irreversible?



## Putting It Together

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Ice on a Lake

*Image by Matthias Groeneveld, pixabay.com, CC0*



Forest Burning

*Image by USFS Region 5, <https://i1ic.kr/p/pcFqae>, CC BY-NC 3.0*

Let us revisit the phenomenon:  
Matter can change form.

1. What causes change in the form of matter?

2. What is the difference between reversible changes and irreversible changes?

A wide-angle photograph of a desert landscape in Utah. The foreground is a dry, reddish-brown plain with sparse, low-lying green and yellow shrubs. In the middle ground, several prominent rock formations are visible, including a large mesa on the left and several smaller buttes and spires in the center and right. The sky is a clear, deep blue with a single, small white cloud near the horizon. The overall scene is bathed in the warm, golden light of late afternoon or early morning.

**Utah State Board of Education**