2nd Grade Science

for Utah SEEd Standards

2nd Grade

for Utah SEEd Standards

Utah State Board of Education 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.

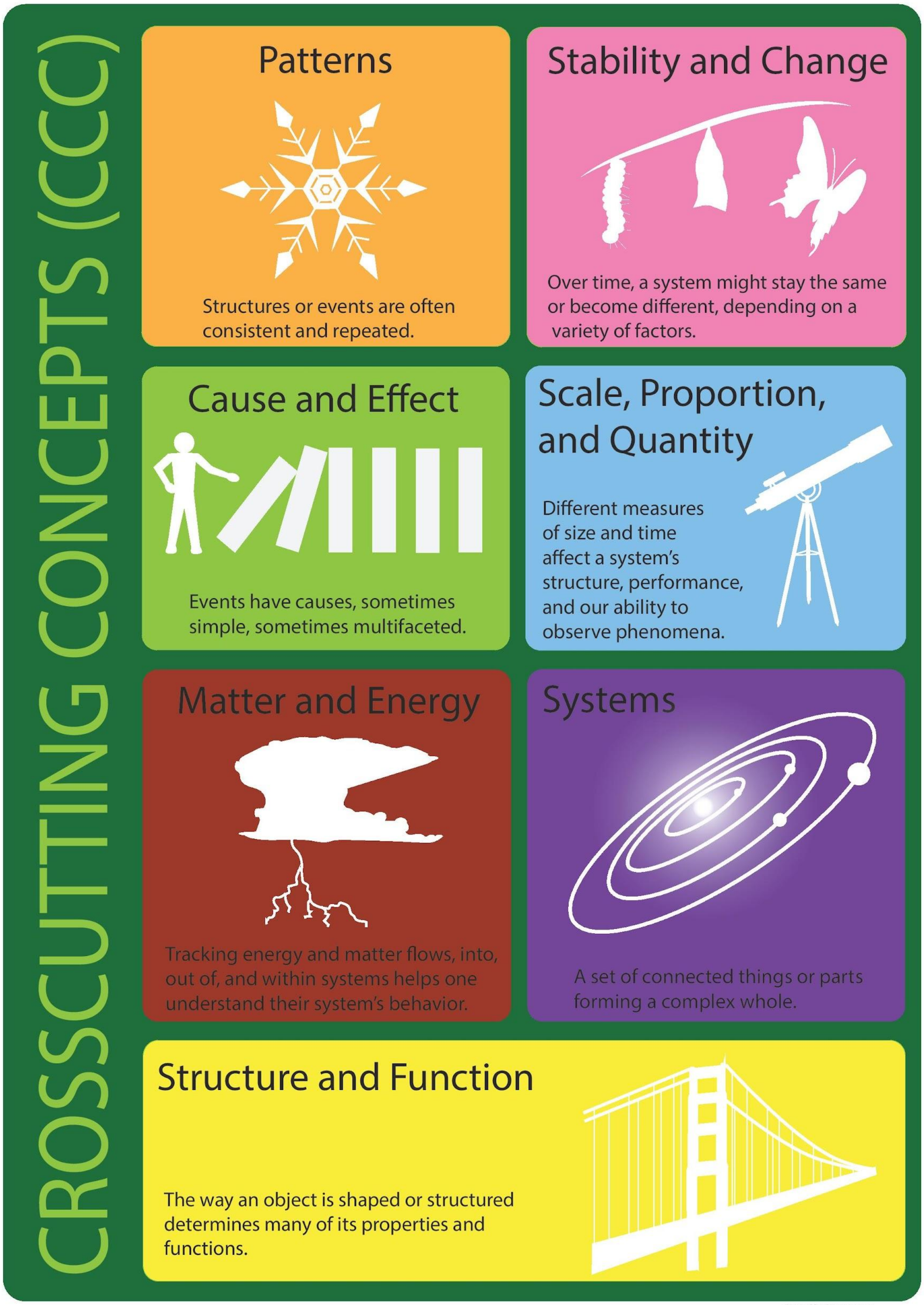
Adam Johnston
Weber State University

Science and Engineering Practices

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

Crosscutting Concepts

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



What is involved in Engineering Design?

Engineering is a creative process where each new version of a design is tested and then modified, based on what has been learned up to that point. This process includes a number of components:

1. Identifying the problem and defining criteria and constraints.
2. Generating ideas for how to solve the problem. Engineers use research, brainstorming, and collaboration with others to come up with ideas for solutions and designs.
3. Use criteria and constraints to evaluate possible design solutions to identify the one(s) that best address these parameters for the problem in context
4. Build and test the prototypes. Using data collected, the engineer analyzes how well prototypes meet the given criteria and constraints.
5. Suggest or make improvements to prototypes to optimize the design.

In the Science with Engineering Education (SEEd) Standards, specific engineering standards generally involve two types of tasks:

1. If the standard includes the idea of designing, then the design process will contain components of defining the problem (along with identifying the criteria and constraints), developing many possible solutions, and optimizing a solution (e.g., determining a best solution for the situation based on the criteria and constraints, testing the solution, refining the solution).
2. If the standard includes the idea of evaluating, then the design process will contain components of defining the problem (along with identifying the criteria and constraints) and optimizing a solution. The idea of developing many possible solutions is not included because various solutions will be provided. The idea of evaluating then means determining a best solution from the provided solutions for the situation based on meeting the criteria and constraints requirements.

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CHAPTER 1

Strand 1: Changes in the Earth's Surface

Chapter Outline

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

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 an important 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)

Phenomenon

You can see water and mountains. Water and landforms are found in predictable patterns.

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

Morača river by Diego Delso; https://en.wikipedia.org/wiki/Mora%C4%8Da#/media/File:R%C3%ADo_Moraca,_norte_de_Podgorica,_Montenegro,_2014-04-14,_DD_09.JPG, CC BY-SA 4.0

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions

You can see land and water outside.

1. What patterns do you see in the landforms?

2. Where do you see water?

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

2.1.1 Landforms

Standard 2.1.1
Develop and use models illustrating the <u>patterns</u> 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. In this picture of Earth, how can you tell the water from the land?

Earth
Image by Joey Littlemore, https://flic.kr/p/gsCrmi, public domain

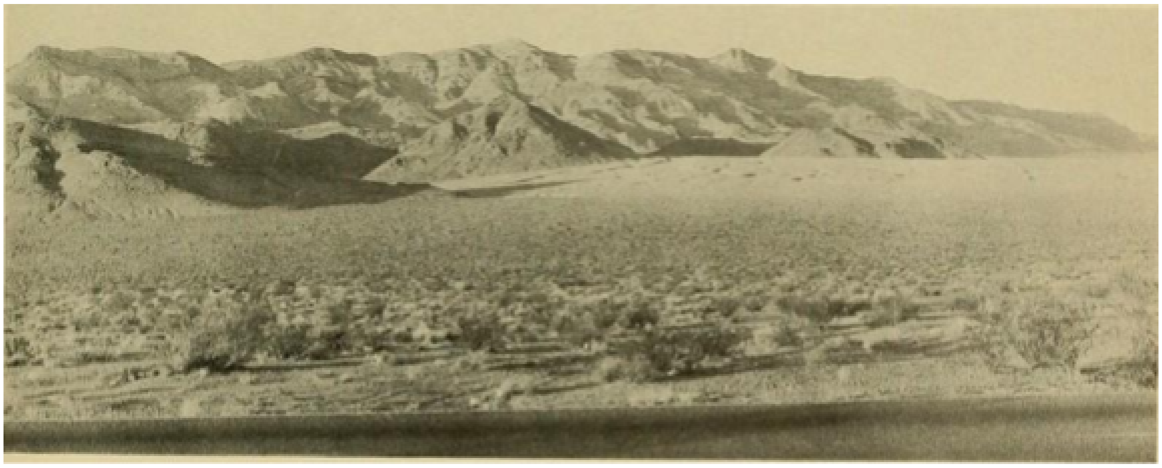
Landforms
Land and water cover the surface of Earth. The ground under your feet is part of the land. Earth’s surface has many features such as mountains, valleys, canyons, and floodplains. These features on Earth’s surface are called landforms. These landforms can also be found at the bottom of lakes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

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?

How are the landforms you see in the pictures similar and different to the landforms near you?

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

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

Morača river by Diego Delso; https://en.wikipedia.org/wiki/Mora%C4%8Da#/media/File:R%C3%ADo_Moraca,_norte_de_Podgorica,_Montenegro,_2014-04-14,_DD_09.JPG, CC BY-SA 4.0

Revisit the Phenomenon:

You can see water and mountains. Water and landforms are found in predictable patterns.

Focus Questions:

1. What are examples of landforms in this picture?
2. Where is water located near the landforms? How did the water get there?

Final Task:

Develop a model to show the patterns of landforms and water on Earth.

1.2 Slow and Fast Changes (2.1.2)

Phenomenon

In these pictures, Earth's surface has changed.

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

Observations & Wonderings:

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions:

1. How do you think Earth's surface has changed in these pictures?

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 explain 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 on Earth's surface or build up Earth's surface to create new landforms.

Slow Changes

During slow changes, landforms made of large 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 weathering. Weathering slowly causes the landforms to get smaller. When rocks are moved to a different place by wind, water, or ice, this is called erosion. 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 do these landforms change slowly?

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://flic.kr/p/h4SWW3, Public domain

Evidence of earthquake

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

Landslide

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

How do these landforms change quickly?

Putting It Together

The Goosenecks

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

Revisit the phenomenon:
In these pictures, Earth's surface has changed.

Focus Question:

1. Explain how Earth's surface has changed in each picture.

2. Explain which picture shows Earth's surface after a fast change?

3. Explain which picture shows Earth's surface after a slow change.

4. How do you think Earth's surface in these pictures will continue to change over time?

Landslide

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

Final Task:
Explain how fast changes and slow changes to landforms are similar and different?

1.3 Prevention (2.1.3)

Phenomenon

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

Cliff Eroding
By InspiredImages, pixabay.com, CC0

Observations & Wonderings

What is the problem in this picture?

What are the possible criteria (positive outcomes) to this situation?

What are the constraints (limitations) with this situation?

Focus Question

What problem will the homeowner have if erosion continues?

What evidence do you have from the picture that the homeowner might have a problem?

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 people 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.

Think 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, 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. Both water and wind can carry soil away to new places.

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 one area to another. 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. How can a large rock wall or sandbags prevent erosion?

Water Erodes Soil
Image by Stephen Gore, https://flic.kr/p/arFUN, CC-BY

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 kansasphoto, https://flic.kr/p/5Qhhb6, CC-BY

Wind can steal soil from other areas. Some areas benefit from this new soil. The red soils of Africa were picked up by the wind and landed in Bermuda. The fertile soils of Illinois were brought in on the wind. The wind took them 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 scientists and engineers study soil loss and work on ways to prevent it.

Can you think of some ways to prevent soil loss?

Soil needs plants to protect it. Plant roots help hold soil 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 wind. By slowing the wind, it prevents the soil from blowing away. How can we protect the soil from wind erosion?

Nigel Chadwick Wikipedia Creative Commons Attribution-Share Alike 2.0 Generic

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://flic.kr/p/eK5i55, CC BY-NC

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

Putting It Together

Cliff Eroding
Image by InspiredImages, pixabay.com, CC0

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

Focus Questions:
Define the problem - What problem 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 would this be the best solution?

Final Task:
Draw a model (a picture that explains or describes) of your

design for slowing or stopping the movement of land.

CHAPTER 2

Strand 2: Living Things and Their Habitats

Chapter Outline

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

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)

Phenomenon

Each of these pictures shows a rabbit. They are both rabbits, but they do not look alike.

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

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions

1. What patterns in their features do these rabbits have in common?

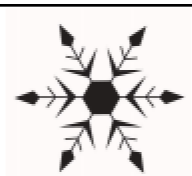
2. What is different about the patterns in the rabbits' features?

3. Do you think that the rabbits live in the same place or in different places?

4. 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 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.

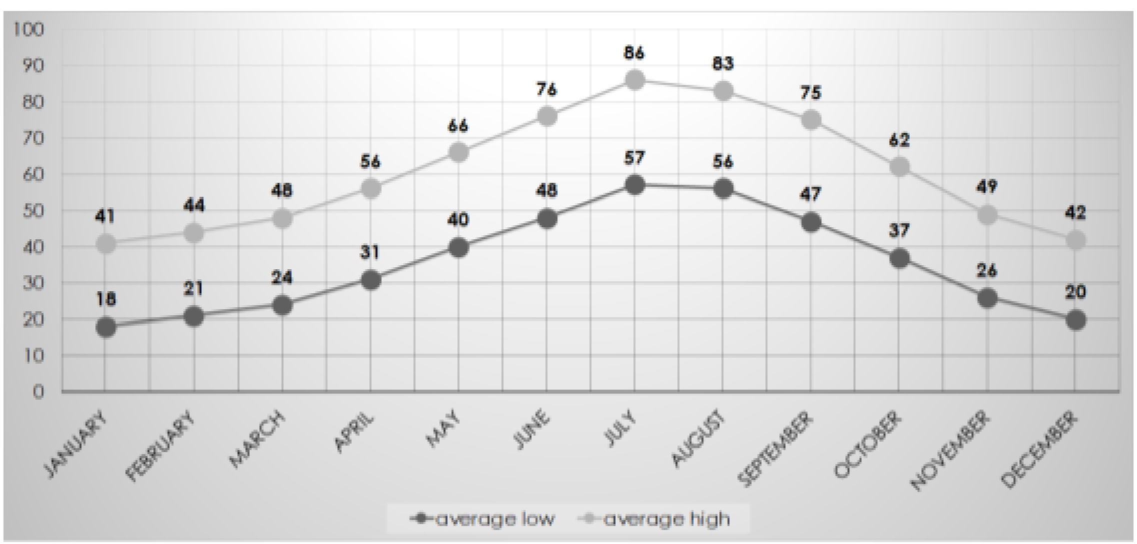
Habitats are Different From Each Other

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

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

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

Below 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. Look at the graph to learn about the temperatures 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, public domain)

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

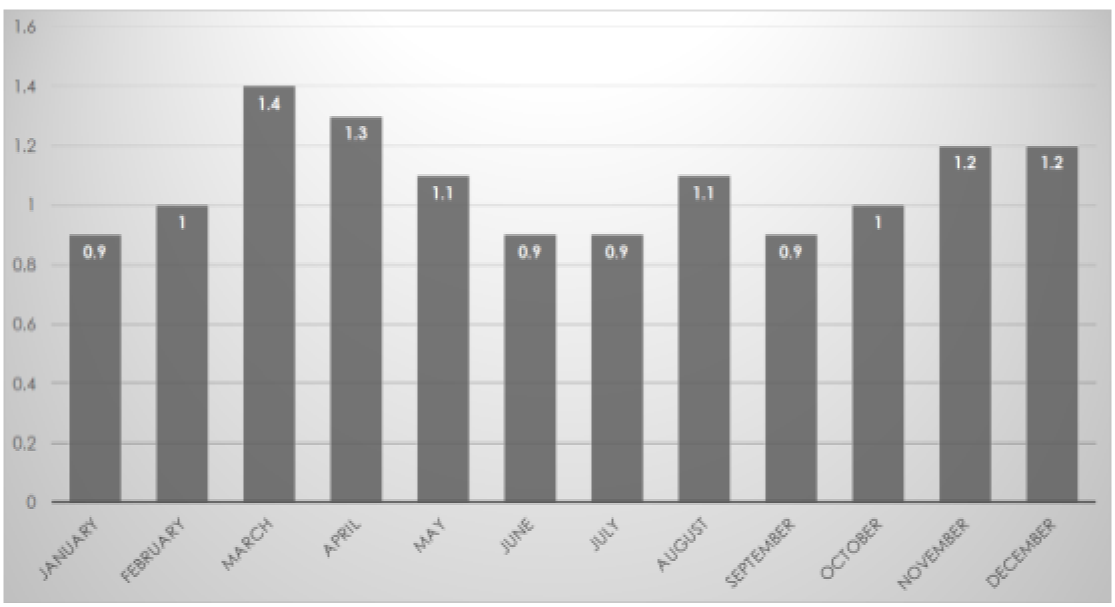
What month has the highest temperature?

What month has the lowest temperature?

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

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

Below 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.



Average Monthly Precipitation in Inches of Great Basin Desert
(data from https://www.nps.gov/grba/planyourvisit/weather.htm#CP_JUMP_26601, public domain)

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 the Great Basin Desert gets in one year?

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

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?

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

Did you see these physical characteristics?

Seaweed in Ocean Habitat
Image by Nichole Bohner, pixabay.com, CC0

Sawfish in Ocean Habitat
Image from PublicDomainImages, pixabay.com, CC0

Harbor Seal in Ocean Habitat
Image by Tom und Nicki Löschner (TomNic-Pics), pixabay.com, CC0

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

Reinbukken på frisk grønt beite by Are G. Nilsen, https://en.wikipedia.org/wiki/Reindeer#/media/File:Reinbukken_p%C3%A5_frisk_gr%C3%B8nt_beite._-_panoramio.jpg, CC BY-SA 3.0

Putting It Together

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

Revisit the Phenomenon: Each of these pictures shows a rabbit. They are both rabbits, but they do not look alike.

Focus Questions:

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 or in different habitats?

4. What is the habitat of each rabbit?

Final Task:

How do the physical characteristics (features) help each of the rabbits survive in their habitat?

2.2 Structure and Function (2.2.2)

Phenomenon

Birds have different beak structures.

Images by
Hummingbird: Domenic Hoffmann
Sparrow:Susanne Jutzeler, suju-foto (suju)
Hawk: Rober Balog (bergadder)
pixabay.com, CC0

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions

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

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

Sea Turtle on Land
Image by skyseeker, https://flic.kr/p/pYxmob, 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.

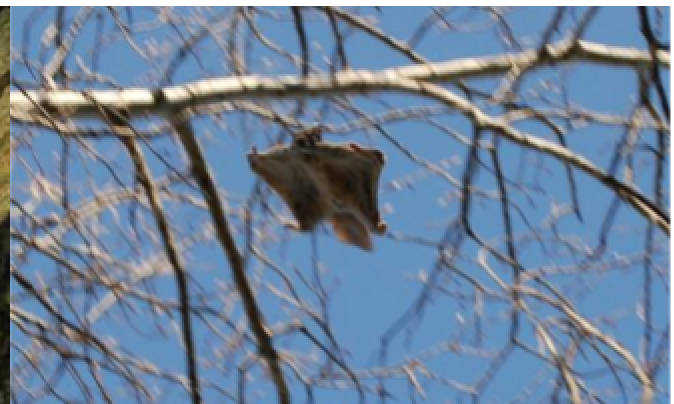
Cactuses in Desert
Image from pixabay.com, CC0

What other structures might allow cacti to survive in their habitat? What is the function of all 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.

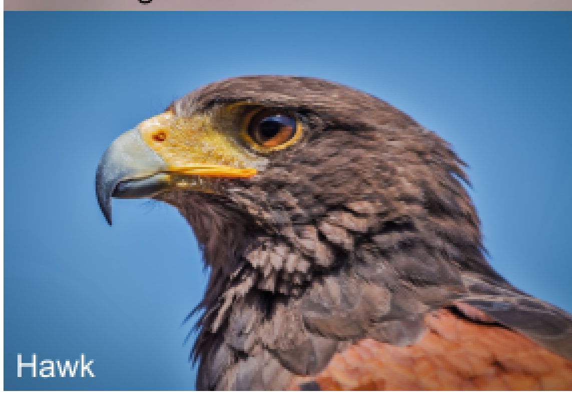
What other structures help flying squirrels survive in their habitat? What is the function of each of these structures?



(Top) Flying Squirrel Gliding in Forest
Image by Angie spuc at English Wikipedia, 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, public domain

Putting It Together



Images by
Hummingbird: Domenic Hoffmann
Sparrow:Susanne Jutzeler, suju-foto (suju)
Hawk: Rober Balog (bergadder)
pixabay.com, CC0

Revisit the Phenomenon:
Birds have different beak structures.

Focus Questions:

1. How is the structure of each bird's beak similar to the others?

2. How is the structure of each bird's beak different from the others?

3. What is the function of the birds' beaks?

Final Task:

Explain how the structure of the birds' beaks help them survive in their habitats?

2.3 Seed Dispersal (2.2.3)

Explore this Phenomenon

Some plants have spiky seeds.

Burdock Seeds

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

Focus Question:

1. Describe the structure of the seeds?

2. How could the structure of the seeds help you understand the function of the seed?

2.2.3 Seed Dispersal

Standard 2.2.3
Develop and use a model that mimics the <u>function</u> 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 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 plant seeds cannot move to a new area on their own, plants 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.

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 (things it needs) to survive, they will begin to grow.

How does getting eaten by animals help disperse seeds?

Seeds Covered in Hooks
Image by Pumuki111, pixabay.com, CC0

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 are pulled off the animals. If the seeds land in an area that has the necessities (things it needs) 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 (things it needs) to survive, they will begin to grow. In the pictures below, 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

Seeds Covered in Hooks
Image by Pumuki111, pixabay.com, CC0

Revisit the Phenomenon:
Some plants have spikey seeds.

Focus Questions:

1) Describe the structure of a seed that would help it move by wind.

2) How does that structure help the seed move?

3) Describe the structure of a seed that would help it move by clinging to animal fur.

4) How does that structure help the seed move?

6) Describe the structure of a seed that would help it move by being eaten by an animal and eliminated through waste?

7) How does that structure help the seed move?

Final Task:

Develop a model (draw a picture) that shows the structure of a seed that moves using animals. Be sure to explain how the structure helps the seed move.

2.4 Mimicking Animals (2.2.4)

Phenomenon

It can be difficult to keep your shoes on if the laces aren't tied.

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

Observations and Wonderings:

What is the problem in this situation?

What are possible criteria (positive outcomes) to this situation?

What are constraints (limitations) with this situation?

Focus Question

1) How do tied laces help keep your shoes on?

2) What do you need to keep your laces tied on your shoes?

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 (what something is made of and how it is made) and function (what it does) of their designs. Sometimes their ideas are mimics, or copies, and the structures and functions of their designs come from living things.

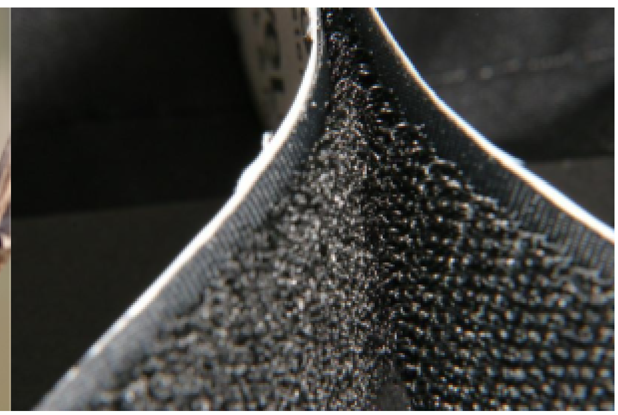
Engineers mimicked the structure and function of a bird wing to create an airplane wing. How are the structures and functions of the bird and the airplane similar?

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 of the seed and Velcro similar?

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



Velcro
Image by Daniel Linwood, https://flic.kr/p/v6qXw, CC-BY-NC-ND

Putting It Together

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

Revisit our Phenomenon:
It can be difficult to keep your shoes on if your laces are not tied.

Define the Problem
Why is it difficult to keep your shoes on if your laces aren't tied?

Gathering Information
What is the function of laces? How do they work?

Final Task - Designing a Solution

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? Consider what might keep the shoes on without having to tie a bow in the lace of the sneaker?

CHAPTER 3

Strand 3: Properties of Matter

Chapter Outline

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 change the properties of that matter forever. Heating or cooling may change the properties of that matter, but the matter can change back to the way it was before the heating or cooling.

3.1 Classifying Properties (2.3.1)

Phenomenon

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

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

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

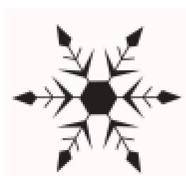
Focus Questions

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?

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 container. 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

Playground by a Lake
Image by Maria (Summa), pixabay.com, CC0

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. What are some similarities and differences in the materials used to build the playground?

Final Task:
Group the materials used to build the playground based on observable properties of the materials. Some observable properties that you could use to classify materials are solid, liquid, texture, strength, or flexibility. Describe what patterns you see in the properties of the playground matter.

3.2 Use and Function (2.3.2)

Phenomenon

Each of these bridges is built differently.

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

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions

1. Who and what might use the bridges in each of the pictures?

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 Hermann Traub, pixabay.com, CC0

Concrete Roads
Image by Pexels, 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.

Metal Necklace
Image by Ella (Ellaspix), pixabay.com, CC0

Metal Building
Image by Anja (cocoparisienne), pixabay.com, CC0

Look at the picture of the necklace and the picture of the building. What observable properties in the structure of metal do you think allow it to function in different ways?

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.

Look at the three pictures below. What do you think each of these materials might be used to build? How could you use the properties in each structure to help you decide how they could function in a design?

Fabric
Image by Skeeze, pixabay.com, CC0

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

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

Playground by a Lake
Image by Maria (Summa), 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?

Putting It Together

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

Revisit the Phenomenon: Each of these bridges is built differently.

Focus Questions

1. What is similar in the function of the bridges?

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

3. What are the different materials of each of the bridges?

Final Tasks

Why do you think the engineers chose these materials for each bridge? How do the observable properties of the structure and the materials used to build the bridges influence the function of the bridges?

3.3 Parts of a Structure (2.3.3)

Phenomenon

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

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

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions

1. What material is each of these objects 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 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 think about how the function changed when the structure was changed. Many different objects can be constructed with the same set of pieces.

Child Building with Blocks
Image by svklimkin (klimkin), pixabay.com, CC0

Look at the picture of the playground again.

What small pieces make up the playground?

Playground by a Lake
Image by Maria (Summa), pixabay.com, CC0

How could these small pieces be disassembled and reshaped to make a new object with a different function?

Putting It Together

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

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

Focus Questions

1) What material is being used to create the fireplace, houses, bridge?

2) What other things can be created with the same material?

Final Task

Develop and use a model to describe how popsicle sticks can be used to create something and then taken apart and used to create a new object with a different function.

Image by Debbie Miller, pixabay.com, CC0

3.4 Changes in Matter (2.3.4)

Phenomenon

Matter can change.

Ice on a Lake
Image by Matthias Groeneveld, pixabay.com, CC0

Forest Burning
Image by USFS Region 5, https://flic.kr/p/pcFqae, CC BY-NC 3.0

Observations and Wonderings

What are you observing about this phenomenon?

What are you wondering about this phenomenon?

Focus Questions

1. What are some ways that matter changes?

2. Can matter change back to its beginning form once it's 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 (can be changed) and changes that are irreversible (cannot be changed).

Matter Changes Form

Freezing Water
Image by M. Maggs (Wild0ne), 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

New Forest Growth
Image by Free-Photos, 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.

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

Revisit the phenomenon: Matter can change.

Ice on a Lake
Image by Matthias Groeneveld, pixabay.com, CC0

Forest Burning
Image by USFS Region 5, https://flic.kr/p/pcFqae, CC BY-NC 3.0

Focus Questions
1. What causes matter to change?

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

Final Task

Look at the pictures on the previous page. Identify the reversible change and explain how you know it's reversible. Identify the irreversible change and explain how you know it's irreversible.