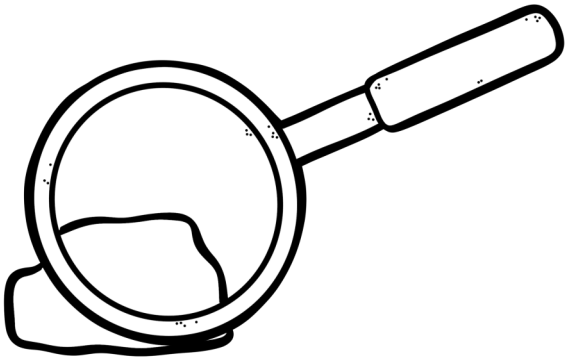
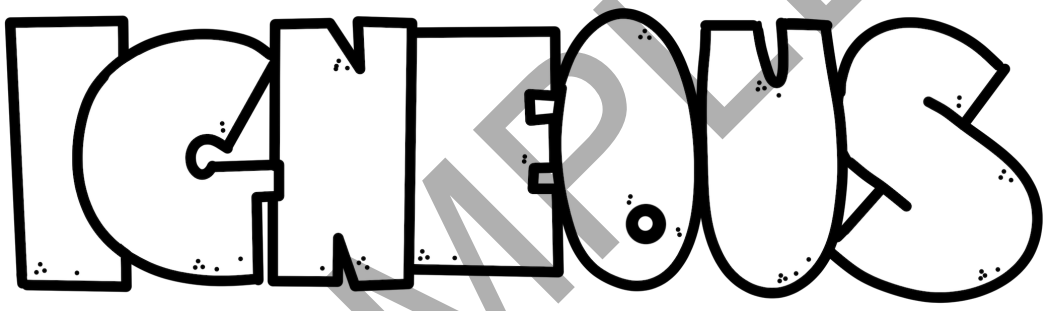
Discovering Rocks, Minerals, & Crystals

When most of us look at rocks, we see just rocks. They might be different colors, but they are pretty much all the same. Or are they? Actually, rocks come in all sorts of sizes, shapes, and colors, and they have many different uses in our world today. There are many ways to separate rocks into groups, but before we start, there are a few words we need to be sure to understand.

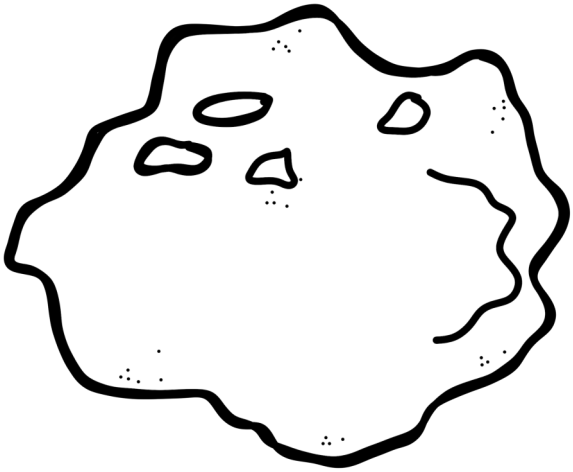


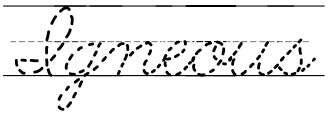
- A rock is a mass of minerals.
- Minerals are collections of certain elements.
- Minerals are usually found in the form of crystals.

Now let's look at three types of rocks—igneous, sedimentary, and metamorphic.



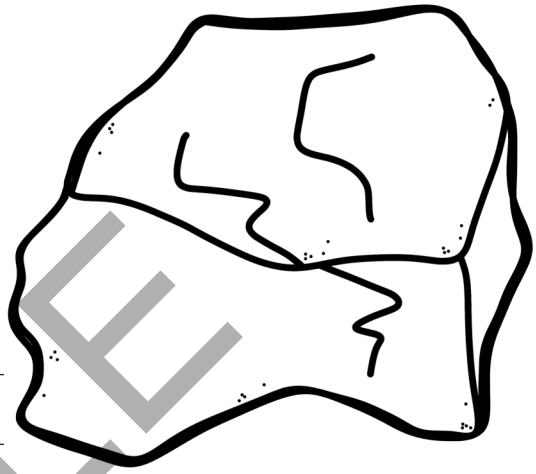
Igneous rocks are rocks formed from magma. Remember magma is molten rock beneath the earth's surface, but it is not the same as lava. When magma erupts out of a volcano, chemical changes take place. So the lava we see outside a volcano is not the same as the magma we see inside a volcano.





SEDIMENTARY

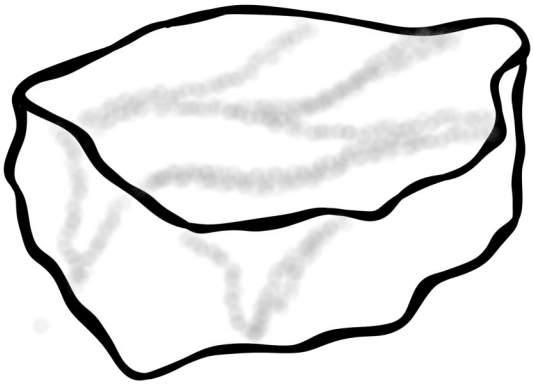
Sedimentary rocks are rocks that are formed when water, wind, or ice carry away small pieces of rocks. They can also be made from decayed plants and animals or from minerals that settle out of a liquid like water. When Mount St. Helens erupted in 1980, it deposited a layer of sediment 25 feet (8 meters) thick in just three hours.



Sedimentary

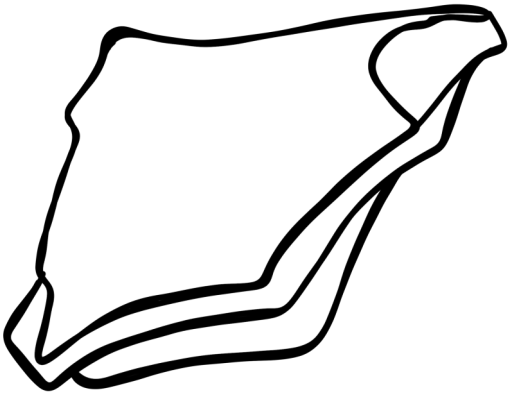
METAMORPHIC

Metamorphic comes from the Greek for "change of form." Sometimes, heat, pressure, or chemicals interact with igneous rocks or sedimentary rocks. When this happens, metamorphic rocks are formed.

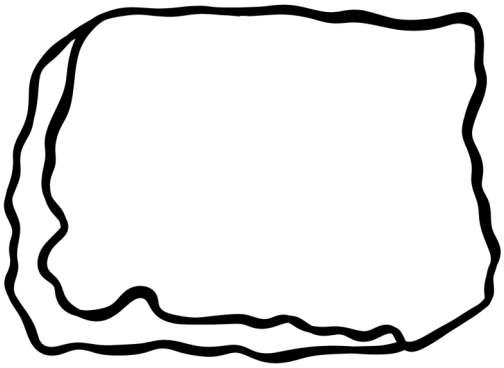


Metamorphic

Shale is a sedimentary rock made up of mud and clay compacted together. It breaks easily into thin layers with sharp edges. We use shale nearly every day. In the past, clay was used to make things like brick, tile, pipes, and pottery, but manufacturers now often grind shale and combine it with water to make a strong clay to use in making these things. It's also used to make cement.



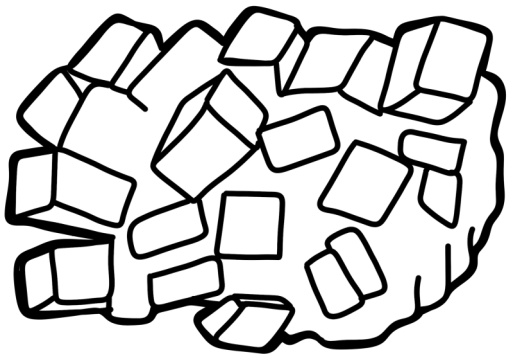
Shale



Limestone

Limestone is a fine-grained sedimentary rock. Limestone forms when calcium carbonate crystallizes out of a solution. It can do this in many different ways. Some of it happens when water evaporates in places like the hot lagoons of a coral reef. Sometimes, it happens as animals such as oysters, clams, snails, corals, and sea urchins die, and their shells, made up of calcium carbonate, are broken apart by the water. Limestone is used as a building material and is used in countless other ways such as making cement, refining metals, and improving soil.

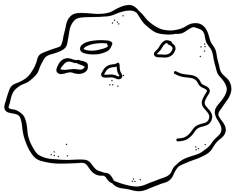
Dolomite is a sedimentary rock made from magnesium carbonate replacing calcium carbonate in marine animal skeletons or from minerals that settle out of seawater. It is often shades of white, gray, and light brown, though it can be other colors if impurities are mixed in. Dolomite is very helpful in manufacturing iron and steel, and it can also be used in paint, putty, and rubber.



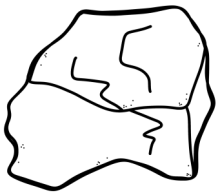
Dolomite

Review

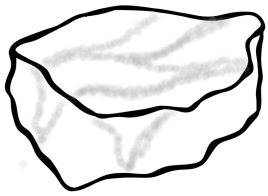
Which of the following is a rock formed from magma? Draw a circle around it.



Igneous



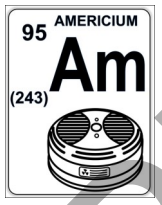
Sedimentary



Metamorphic

Which element is not found in the minerals rocks are made of? Draw an X through it.

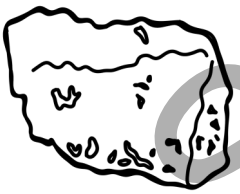
Oxygen



Americium

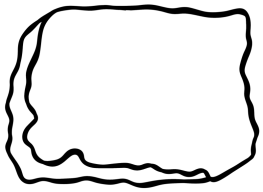
Silicon

Which of these is not an igneous rock? Draw an X through it.



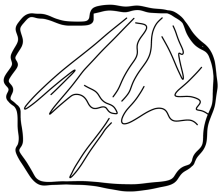
Diorite

Granite



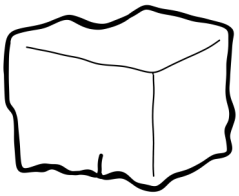
Limestone

Which of the following metamorphic rocks is a popular material for sculptors? Draw a circle around it.



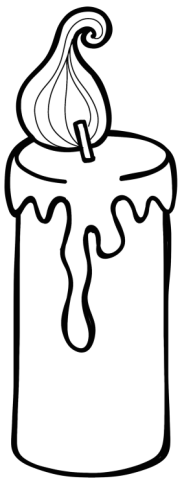
Marble

Schist



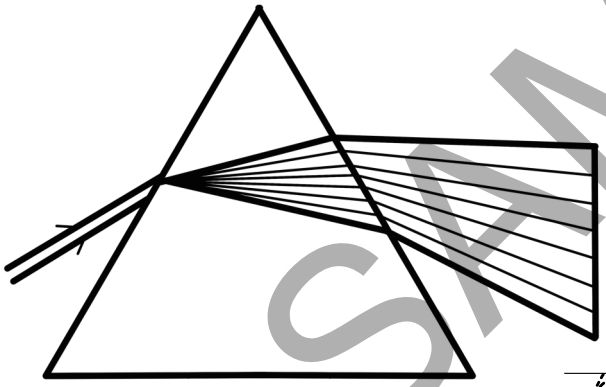
Quartzite

LIGHT



It would be impossible to have life as we know it without light. Light is one of the most basic types of energy. We see it when the sun is shining, when we turn on a lamp, or when we burn a candle. Plants use sunlight to make the food they need to grow. We also use it in ways we can't see, in machines like X-rays, microwaves, and radios.

Light travels through air, water, and even space. It moves in a straight line until something stops it. When an object stops it, it absorbs some of the light and bounces the rest back. Then that light travels until it hits something, and so on. When the light reaches our eyes, we can see. Light is made up of both waves and particles. We can learn about these waves when we study light as it goes through something called a **prism**.



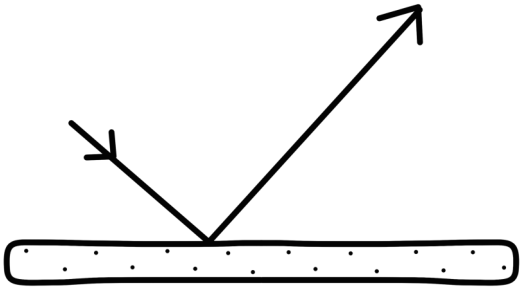
Even though light usually looks white, it's actually made up of light with different wavelengths, some long and some short. Each wavelength is a different color. When we shine light through a prism, the prism breaks it down into its different wavelengths, or colors.

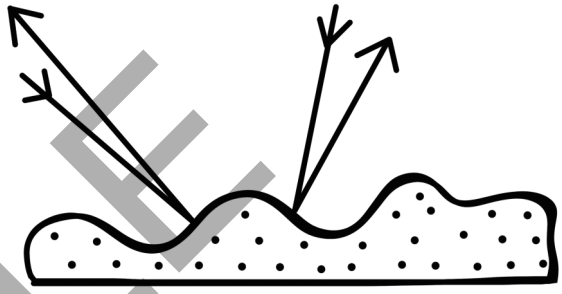
Prism

This is why objects have color. When light hits something we see as black, the object absorbs most of the colors of light and sends very little light back. When light hits a white object, it only absorbs a tiny bit of light and sends most of the light back to us. When we see a red object, like an apple, it's because the apple absorbed all the colors of light except the red wavelengths. It sends the red light back to us, so we see red. When an object bounces light back to us, we call it either reflection or refraction. Let's see what makes those two terms different.

REFLECT

When light hits an object, and the object scatters the light and bounces it back to us, it's called **reflection**. We can see that when light hits a smooth surface like a mirror or even when it hits a rough surface like a wall. The light hits it and is bounced straight back to us.

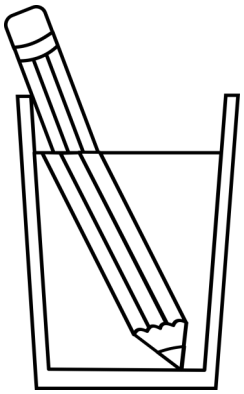




Reflection

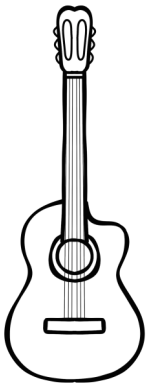
REFRACT

Sometimes, the light is bent before it bounces back to us. If you put a pencil in a cup of water, it looks like it is bent. It's not actually the pencil that is bent but the light. When the light moves from the air to the water, it changes speed and appears to bend. That is called **refraction**.



Refraction

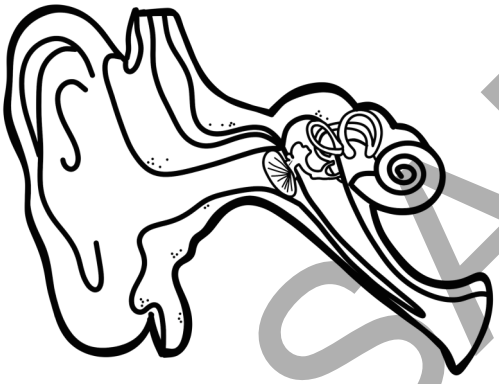
SOUND



Sound is a type of energy that comes from something that vibrates, or moves back and forth. If you pluck a string on a guitar, the string moves back and forth very quickly. The vibration of the string makes the air around it move. That movement is called **sound waves**.

We can't see sound waves, but you can imagine what they look like if you picture tossing a pebble into a pond. The pebble causes ripples of water to move out in all directions. Those ripples are a little bit like sound waves.

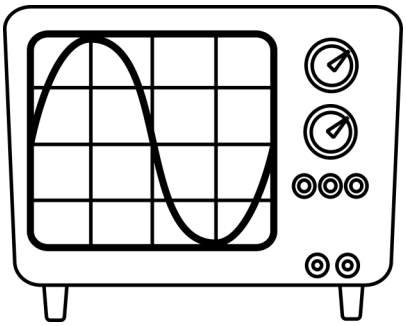
Unlike heat and light, sound has to have air in order to move. If you were somewhere without any air, like outer space, you could not hear sounds.



On earth, when sound waves reach our ears, they make our eardrums vibrate. This vibration is turned into signals our brains can understand, which allows us to hear what is going on around us.

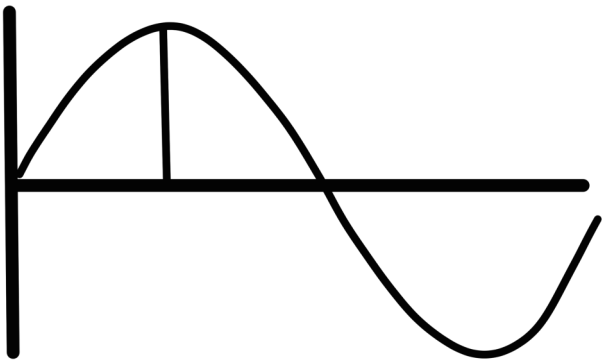
sound waves

A sound wave has two parts, peaks and troughs. The peaks are the high points of the wave; the troughs are the low parts between the waves. How high or low those peaks and troughs are, and how fast or slow they move, determines a lot of things about what we hear.

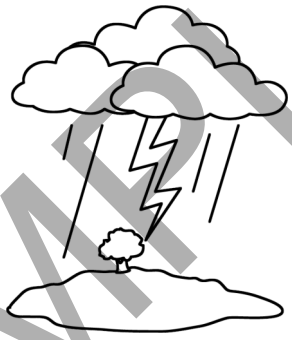


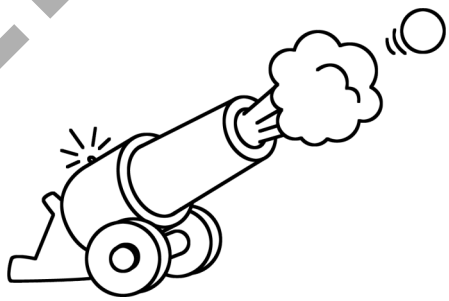
Every day, we hear loud sounds and soft sounds, high-pitched sounds, and low-pitched sounds. What is the difference between them? Let's find out!

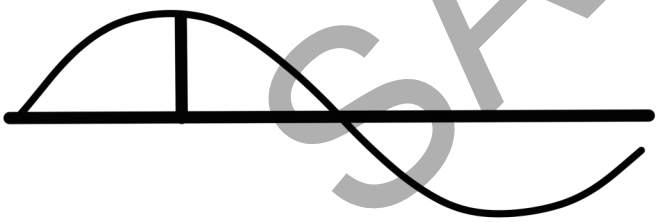
A **loud** sound has more energy than a soft sound. The amount of energy in a sound is called its amplitude, and the amount of loudness a sound has is called its volume. When you measure sound waves, a loud sound has high peaks. A loud sound could be something like a cannon shot, an emergency siren, or a thunderstorm.



Loud

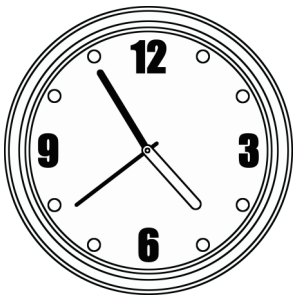


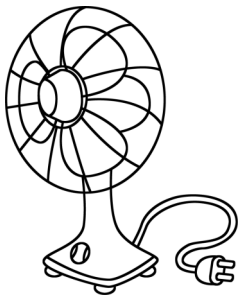


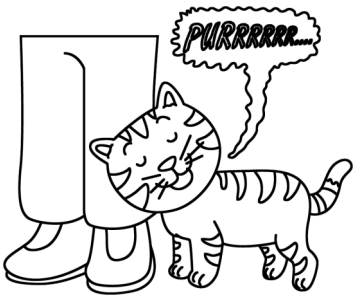


A sound can also be quite **soft**. It has less energy, or less amplitude, so it is quieter. The peaks are not nearly as high as loud sounds. We hear soft sounds every day, like the ticking of a clock, the purring of a cat, the sound of footsteps, or the whirring of a fan.

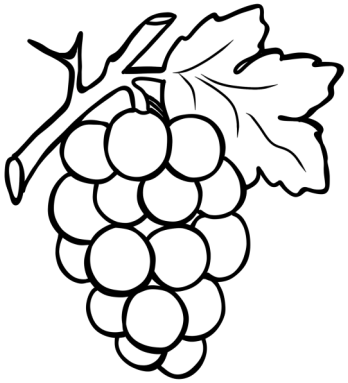
Soft





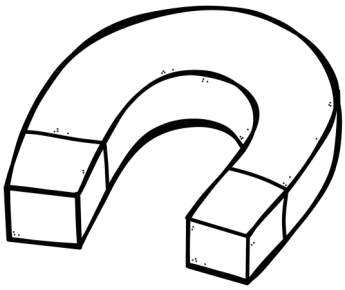


The last type of energy we're going to look at is chemical energy. Chemical energy is stored in the electrons of atoms and has to be converted into other types of energy we can use.



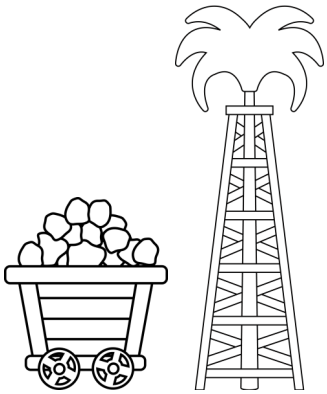
Your body does this every day. It breaks down the food you eat and releases chemical energy. Then your body converts that energy into what your body needs.

Your vehicle probably also uses chemical energy to get the power it needs to move. As a vehicle burns gasoline, the chemical energy is released and converted into the other types of energy your car needs to operate.

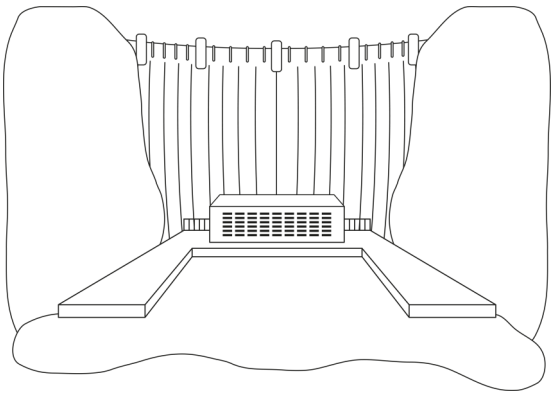


There are many different ways to generate electricity. You can even generate electricity with a magnet! We generate electricity using fossil fuels, water, sunlight, heat, wind, and by splitting apart atoms. Let's see some of the ways we convert different types of energy into electricity.

Fossil-fueled steam electric power **plants** generate most of the electric power in the world. These plants burn coal, oil, or natural gas, which produces heat. The heat turns water in a boiler to steam. The steam is superheated and driven through a huge turbine at high pressure. The turbine is a machine with wheels and blades like a fan. It turns a shaft, that turns part of a generator, which generates electricity.



Fossil-fueled plant



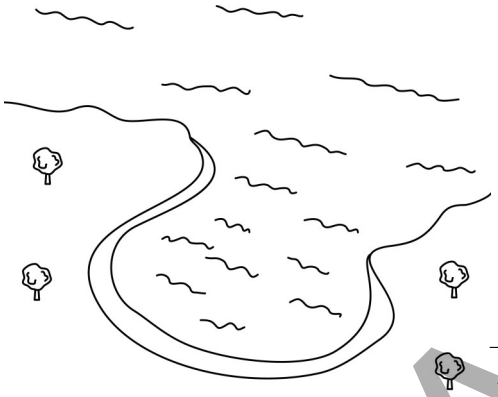
A **hydroelectric plant** also generates electricity by using a turbine to operate a generator that produces electricity, but instead of fossil fuels, a hydroelectric plant uses water stored behind a dam.

Hydroelectric plant

Exploring the Earth's Landforms

What is a **landform**? A landform is anything distinctive about the surface of a planet, moon, or asteroid that happens naturally. In other words, it's not something manmade but something that happens as a result of things such as erosion, earthquakes, floods, volcanic eruptions, the movement of glaciers, the action of rivers, etc. There are many different types of landforms, but we're going to look at some of the ones most common on Earth and see how we can tell some of them apart.

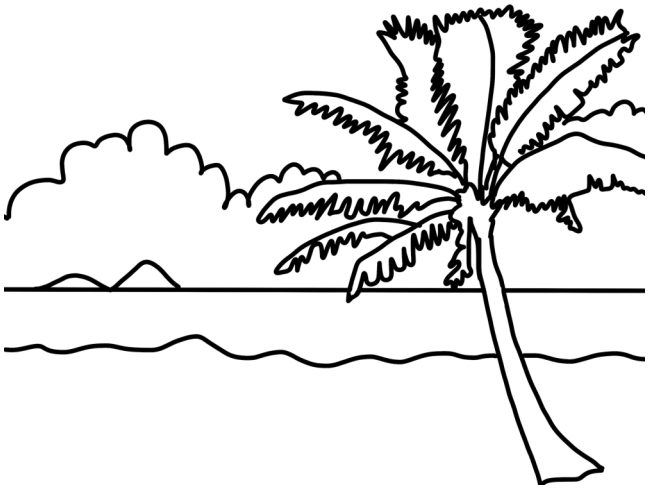
Landforms



A **bay** is a body of water, smaller than a gulf, that is partially surrounded by land. There are bays in every part of the world, such as the Bay of Bengal in Asia, the Hudson Bay in North America, and the Bay of Biscay in Europe. A bay in Russia near Lake Baikal, called Provo Bay, was created in 1862 by an earthquake that hit the region.

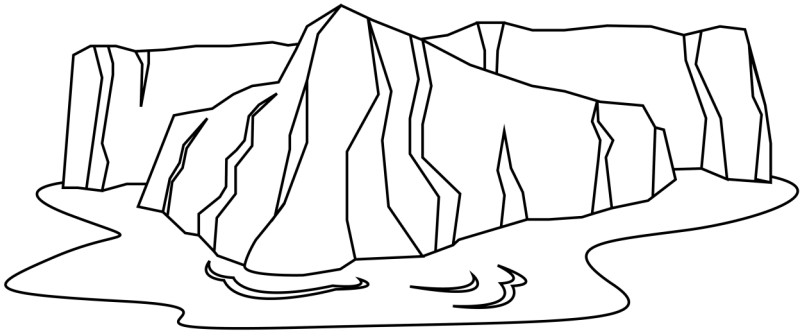
Bay

You can find a **beach** anywhere you find sand, pebbles, or rocks along the shoreline where water meets land. A beach can be warm and tropical, like the beaches of Caribbean islands or Australia, or they can be along the frigid waters of the Arctic Ocean like Barrow Beach in Alaska in the United States.

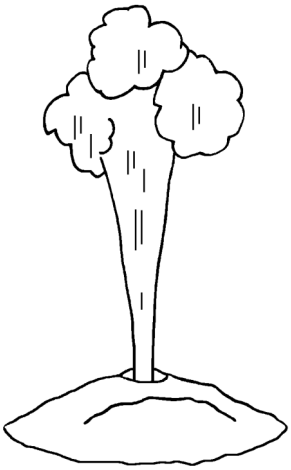


Beach

Glaciers are tremendously large pieces of ice that slide and move because of the pull of gravity. As they slide down hills and valleys, they flatten some landforms and create new ones.



Glacier



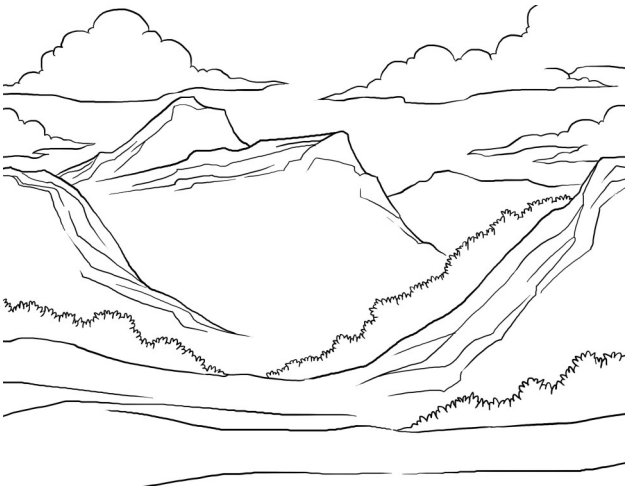
A **geyser** is a spring that shoots hot water, often in a great stream that can be more than 100 feet (30 meters) high, though some only bubble a little at the surface. There are geysers in different parts of the world. There are at least 300 active geysers in Yellowstone Park in the United States alone. There is a group of geysers in barren lava fields 7 miles (110 kilometers) from Reykjavik, Iceland, and there is another group of geysers in New Zealand.

Geyser

A **gorge** is similar to a canyon in that it is usually a valley surrounded by steep and rocky sides, but gorges are narrow and usually have a stream flowing through them. Sometimes the words are used interchangeably, meaning that some people call the same landform a canyon or a gorge. You can find gorges all over the world. Murchison Gorge is located in Western Australia, Torssachs is a gorge found in Scotland, and the Delaware Water Gap is a gorge in the northeastern United States.

Gorge

A **valley** is a natural dip in the Earth's surface. Many valleys pass between hills or mountains. Often times, the bottom of the valley, called the floor, has soil that is excellent for growing things. Just like hills and mountains, you can find valleys in all parts of the world, such as the Shenandoah Valley in the United States, the Great Rift Valley in Africa, and the Swat, a valley in Pakistan in Asia.

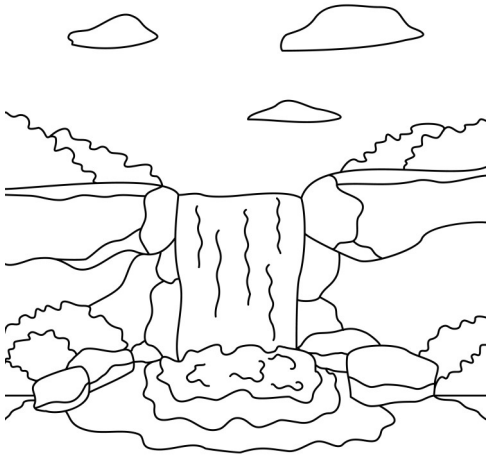


Valley

A **volcano** is an opening in the earth's crust at the top of, or sometimes on the sides of, a mountain or hill. Volcanoes are known for their eruptions of lava, ash, rocks, and gases. They can be various shapes and sizes. Shield volcanoes, like Mauna Loa in Hawaii, are some of the largest in the world. Other volcanoes are cone-shaped and include volcanoes like Krakatau in Indonesia, Mount Pinatubo in the Philippines, and Vesuvius in Italy.

Volcano

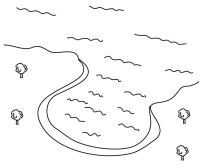
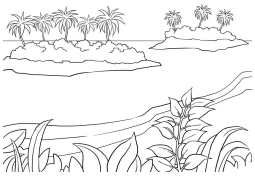
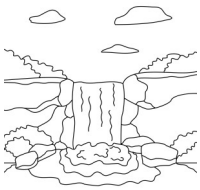
A **waterfall** is a flow of water from a steep, high place. Waterfalls happen all over the world. The highest waterfall is Angel Falls in Venezuela. It stands 3,212 feet (979 meters) tall. The waterfall with the largest amount of water is Victoria Falls in Africa, on the border between Zambia and Zimbabwe. The Jog Falls in India cascades over one cliff and then break into four smaller waterfalls.



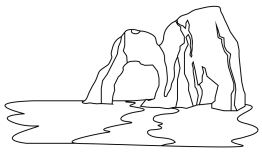
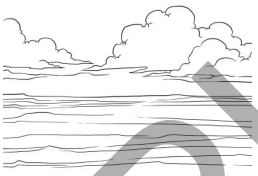
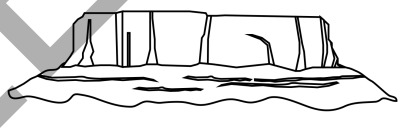
Waterfall

Review

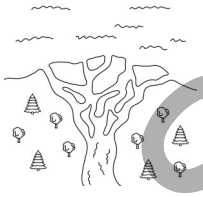
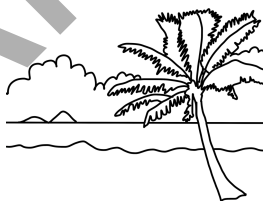
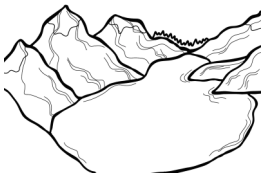
Which of the following is a bay? Draw a circle around it.

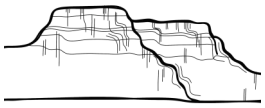
Which of the following is a mesa? Draw a circle around it.

Which of the following is a delta? Draw a circle around it.

Which of the following is a plateau? Draw a circle around it.


Weather

Weather has three main parts: **sunlight**, **water**, and **air**. These three things create all the weather for the entire planet. Let's start by looking at the job of sunlight.

Sunlight

We know the light from the sun heats the air that surrounds our planet. It heats different parts of the planet different amounts. For example, the air close to the equator is hotter than the air at the poles.

The amount of heat in the air also depends on the time of day. Have you noticed that usually, it is warmer in the daytime than it is at night? That is because our earth is rotating on its axis. As it turns, the part of the planet receiving the most energy from the sun changes.

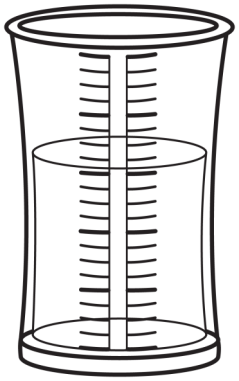
As the air in one place heats up and the air in another place cools down, it causes the air to move. We feel this movement as wind.

Air

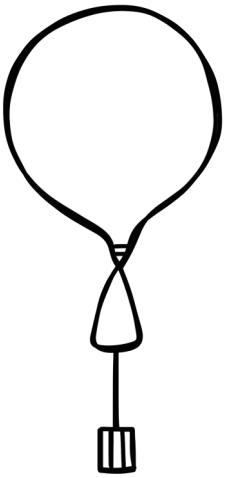
What about water? As the sun warms the water on the earth, some of it evaporates into a gas called water vapor. The amount of water vapor in the air determines the humidity. Humidity is why some days feel hot and sticky while other days feel dry and scratchy. Water also collects in the air in the form of clouds.

Water

A **rain gauge** is important for measuring how much rain has fallen in a specific place during a certain time. This is important to record so meteorologists have a record of what the weather has done over time, and it's important for predicting if an area is in danger of not receiving enough rain and having a drought.



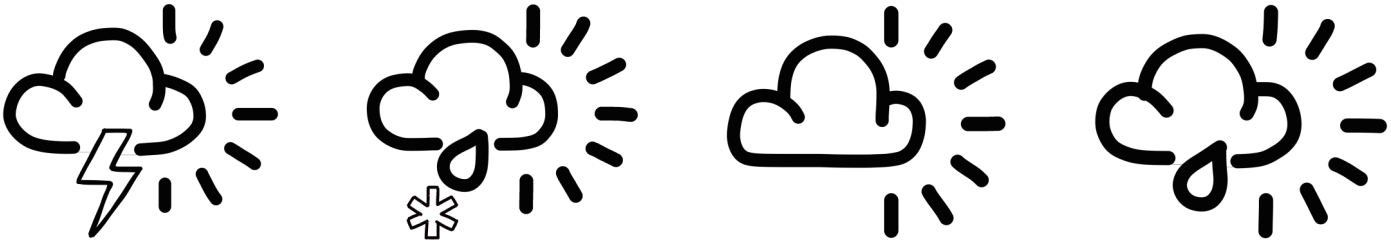
Rain gauge



Weather balloons are scientific devices meteorologists use to take readings high up in our atmosphere. They record the three important factors about air that are necessary to understand and forecast the weather—the air temperature, air pressure, and humidity.

Weather balloon

Why do you think it's important to record so much data about the weather? One way scientists use this data is to forecast what changes in the weather are coming. As they see changes in air pressure, they know a storm could be coming. When precipitation is in the forecast, the temperature can determine whether we see rain or snow. Meteorologists also record this data for use in the future. The information they record today can help meteorologists several years from now know what is normal and what is unusual for an area. All of this data helps meteorologists forecast what weather we should expect, which helps us know how to dress, when we might need to leave early for a trip, and when it might be safer to stay home. When a storm or extreme weather is on its way, meteorologists can help save lives by letting people know what to expect and how to prepare and stay safe.



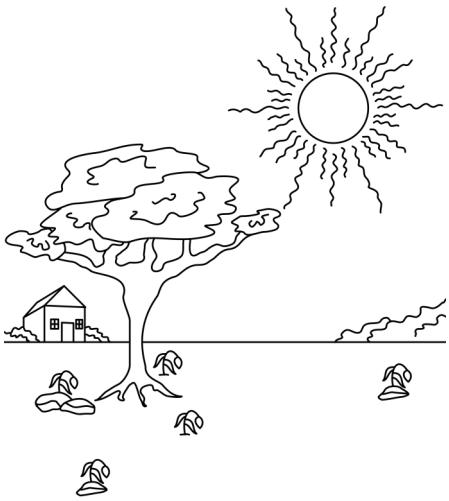
Floods can be caused by many different circumstances, but one of the common ways a flood happens is when rain falls in an area faster than the ground can absorb it or drain it away. Floods can be small and affect only a few blocks or they can be large and affect entire towns. Meteorologists help people stay safe and protect their homes by knowing how much rain has fallen and how much rain is expected.

Flood

Fog is a lot like clouds, but fog touches the ground in places. It's made up of water vapor. If the air is cool and has more water in it than it can hold, fog can form. As the air heats up, the fog disappears. Fog can make it hard to see to drive, so it's important for meteorologists to warn people when fog might be in an area.

Fog

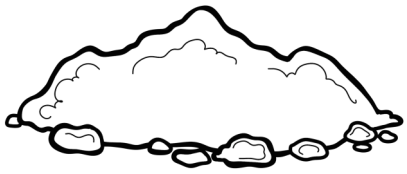
A **drought** happens when an area gets far less than average rainfall over a period of time, such as months or even years. Droughts cause crops to die, and they increase the chance of a wildfire happening. In some places, a drought can lead to a dust storm as the soil dries out and is more easily picked up by the wind.



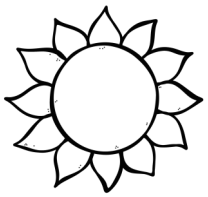
Drought

Review

Which of the following is not a main ingredient in weather? Draw an X through it.



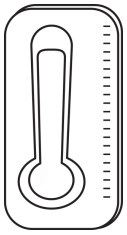
Dirt



Sunshine

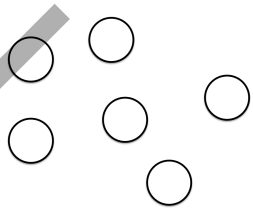
Water

Which of the following is determined by the amount of water vapor in the air? Draw a circle around it.



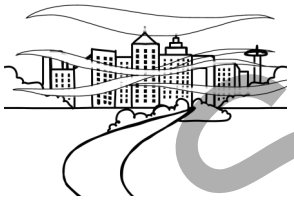
Air temperature

Air pressure



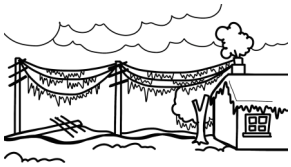
Humidity

Which of the following is caused by freezing rain? Draw a circle around it.



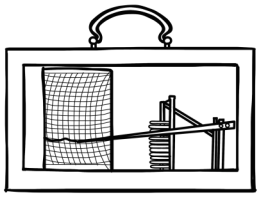
Fog

Mud slide

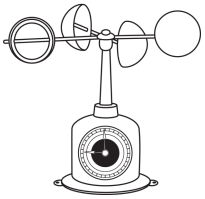


Ice storm

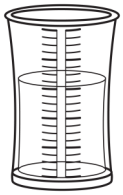
Which of the following measures the speed of the wind? Draw a circle around it.



Barograph



Anemometer



Rain gauge

Kinds of Animals and How They Live

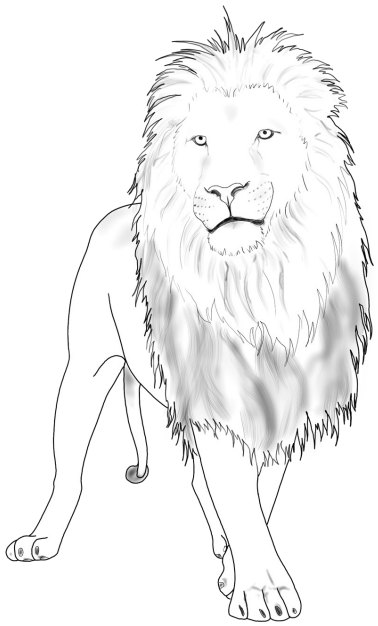
I'm sure you've noticed there are a LOT of different animals in the world. From the largest whale to the smallest insect, you can find animals almost anywhere you look. In order to study them, scientists group animals by their characteristics, what they have in common. For example, think about your dog and your cat. If you take a close look at them, you'll see they have many things in common. They both give birth to live young instead of laying eggs. This makes them both *mammals*. They both have a backbone, which makes them *vertebrates*. Let's take a closer look at some of the terms scientists use to group animals by what they have in common and find out more about some of these incredible creatures.

Vertebrates

The first group of animals we're going to study are **vertebrates**. We already mentioned that vertebrates are animals that have a backbone. They also have a cranium, which is a case for their brain.

Most vertebrates have backbones (or spinal columns) made up of a series of bones called vertebrae, but some animals, like sharks, have vertebrae made of cartilage instead.

All vertebrates are bilaterally symmetrical, which is just a fancy way of saying their left side and their right side are mirror images of each other. You can see that with the first vertebrate we'll study, the **lion**. If you draw a line down the middle of a lion, each side has two legs and feet, one eye, one nostril, etc.



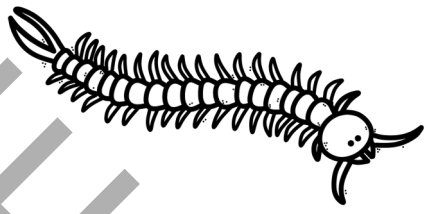
Lions are mammals that need a lot of space to move around and prefer woodlands and grassy plains. They also need lots of prey, such as deer, antelope, and zebras. Only a few hundred lions live in Asia, in a protected area of India. The rest roam about Africa, mostly in protected areas such as national parks or reserves, where they are safe from hunters. A male lion often weighs between 350-400 pounds (159-180 kilograms) but can weigh as much as 560 pounds (254 kilograms). They are usually about 9 feet (3 meters) long and 4 feet (120 centimeters) high at the shoulder.

Lion

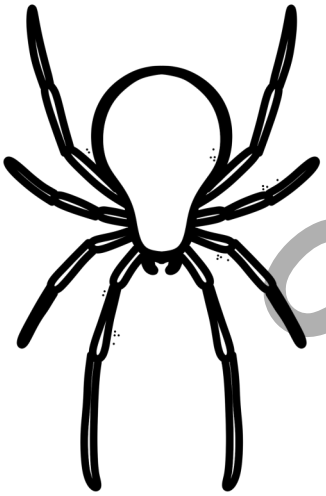
Invertebrates

As you have probably guessed, since a vertebrate is an animal with a backbone, an invertebrate is an animal that does not have a backbone. Invertebrate animals actually make up about 95% of all animals in the world! How can that be? Scientists estimate there are as many as 10 million kinds of invertebrates or more in the world. Invertebrates include insects, spiders, worms, crabs, shrimp, lobster, jellyfish, sponges, starfish, snails, and many other types of creatures. We'll take a look at just a few of them.

A **centipede** is an invertebrate that also belongs to the arthropod group of animals, which we'll take a closer look at later. Centipedes are known for their many, many legs. Even though the first part of the centipede's name means 100, not all centipedes actually have 100 legs. Centipedes have bodies that are divided into many segments, and each segment has a pair of legs except the last one. Some centipedes only have 15 segments (or 30 legs), while some could have more than 180 segments (or 360 legs)!



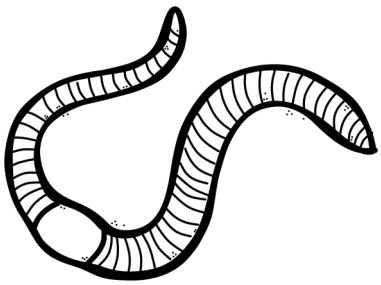
Centipede



The **spider** is an animal we are all familiar with. Like the centipede, it belongs to the invertebrate animal group as well as the arthropods. Even though we often refer to spiders as insects, that's not technically true. In science, an insect has six legs and usually has wings and antennae. Spiders have eight legs, and they don't have wings or antennae. There are thousands of different types of spiders, and they live in most parts of the world. Many of them also spin beautiful silk webs they use to capture food.

Spider

The **earthworm** has two types of muscles, some that go around its body that it uses to shrink up skinny or spread out, and muscles it can use to shrink up short or stretch out long. It does not have eyes, ears, or lungs but breathes through its skin. Its body is like two tubes, one on the inside that digests its food, and one on the outside of its body that we can see.

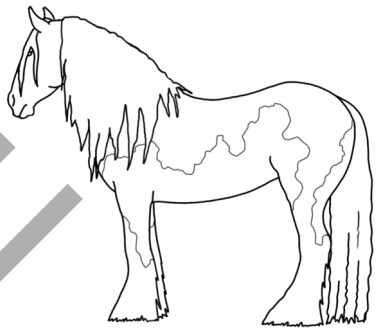


Earthworm

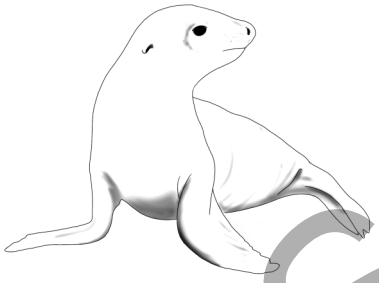
Mammals

Mammals are vertebrates that live all over the world. There are more than 4,500 different kinds of mammals, but they have some things in common. Most mammals give birth to live young, though two mammals—the platypus and the echidna—are mammals that lay eggs. All mammals have hair, and they are all warm-blooded. Many of the animals we interact with everyday, such as dogs and cats, are mammals, and so are lions, cows, elephants, seals, whales, and even bats.

Horses are mammals with characteristics that make them very good workers and runners. Their long, strong legs give them speed to run and strength to pull. Their wide nostrils help them breathe all the air they need to keep their muscles working so hard. Today, there are more than 150 breeds and types of horses, including ponies. Some are quite small, while the largest breed of horse, the shire, can be more than 68 inches (173 centimeters) tall and weigh more than 2,000 pounds (910 kilograms).



Horse



Seal

Seals are a type of mammal that usually live in the ocean. They have flippers that make them excellent swimmers, and most eat fish and other small ocean creatures. Fur seals have thick coats of fur to keep them warm while many other types of seals use a think layer of blubber to keep out the cold.

Bats are the only mammals that can fly. People often think bats are blind, but that's not true. All bats can see, and some can actually see very well. Bats also use echolocation to sense their surroundings. Echolocation is bouncing sounds off of things and collecting information from the echoes that bounce back. There are more than 1,000 different types of bats in the world, and they live almost everywhere except the arctic and Antarctica. Many types of bats are extremely helpful to humans because they eat large amounts of insects and help keep the insect population under control.

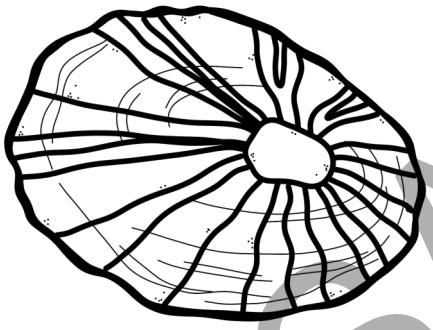
Bat

Mollusks

Mollusks are soft-bodied invertebrates that don't have any bones at all. Some of them have a hard outer shell that helps protect them. Some have thin shells inside their bodies instead. They have tentacles that help them learn about their surroundings. Mollusks include snails, slugs, clams, octopuses, squids, and other animals.

Cuttlefish are mollusks with an inner shell called a cuttlebone. They have eight short arms and two long tentacles. They use a fin to swim and change direction. They also squeeze water through a funnel in their bodies to help propel them forward. If you don't measure the arms and tentacles, cuttlefish are usually about 2 to 20 inches (5 to 50 centimeters) long.

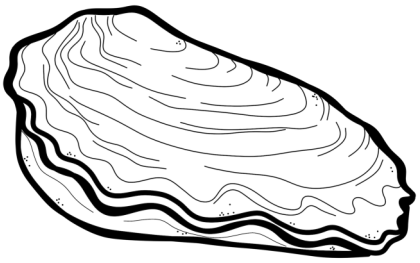
Cuttlefish



Limpet

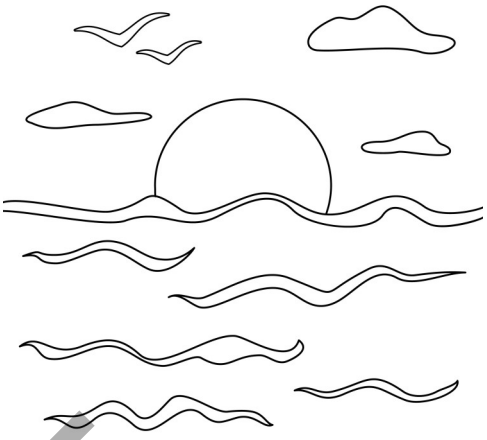
Limpets need their hard shells to protect them from animals like crabs and birds that would like to eat them. They are usually less than 3 inches (8 centimeters) long, though one kind can grow bigger. The limpet's soft body moves by using a muscle called a foot that holds onto rocks like a suction cup. Limpets have long tongues they use to eat seaweed off of the rocks.

Oysters are invertebrates and mollusks people have known about for thousands of years. Their meat is a popular seafood, and some types of oysters produce precious pearls that are treasured around the world. An oyster's shell is made of two parts called valves that are held together by an elastic ligament that works like a hinge. A special muscle holds the shell opened or closed, and when it needs to, an oyster can close its shell tight and live without opening it again for weeks.



Oyster

Life in the Ocean's Hidden Zones

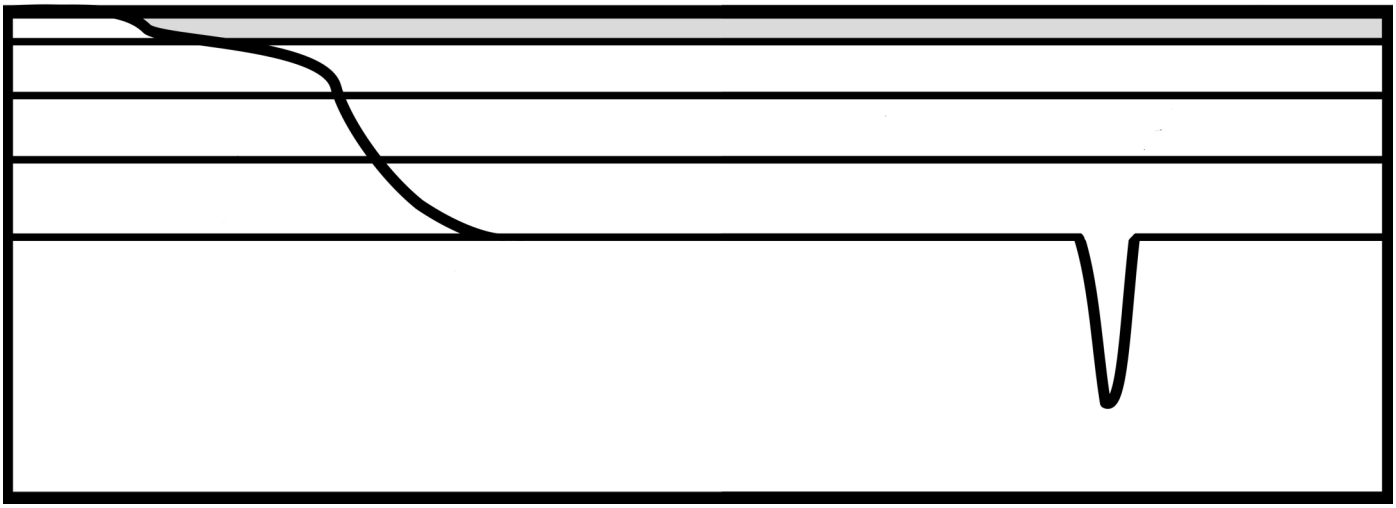


Have you ever looked at the ocean and just seen—water? I mean, there are some waves and fish and things like that, but it's pretty much just lots and lots of water, right? Actually, no. There are tens of thousands of different kinds of animals that live in the ocean, including some of the strangest and most amazing creatures you've ever seen. The ocean is an incredibly difficult place for animals to live. Once you get very far below the surface of the water, the temperature goes down, the pressure goes extremely high, and even sunlight can't reach. How could any animal survive in such a harsh environment? That's what we are going to find out.

When we talk about animals that live in the ocean, it's helpful to divide the ocean into zones. Each zone goes deeper and deeper. Keep in mind that the deeper in the ocean you go, the colder and darker it is and the more pressure that surrounds every living thing.

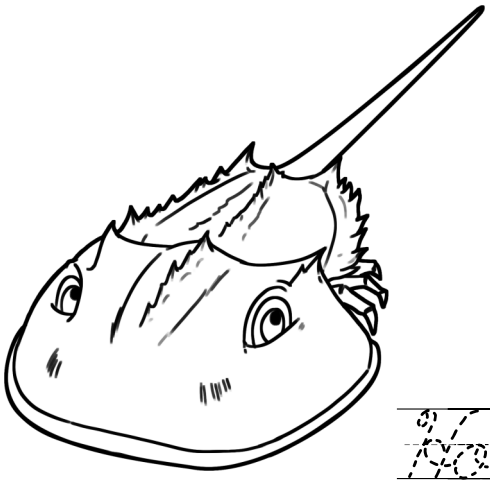
Most of the ocean life we are familiar with lives in the first zone. This is called the **sunlight zone** (or the photic or epipelagic zone). This is the surface of the ocean and about 650 feet (200 meters) beneath it. This zone receives the most sunlight, making it possible for plants to grow using photosynthesis. Some of the animals that live in the sunlight zone can also dive deeper or live in deeper parts of the ocean but are commonly found in the top zone.

Sunlight Zone



The **conch** is a large sea snail most known for its beautiful white, pink, yellow, or orange shell. The queen conch that lives in tropical waters off of North America can grow as long as 1 foot (30 centimeters). Its long, heavy shell has been used as a trumpet for thousands of years.

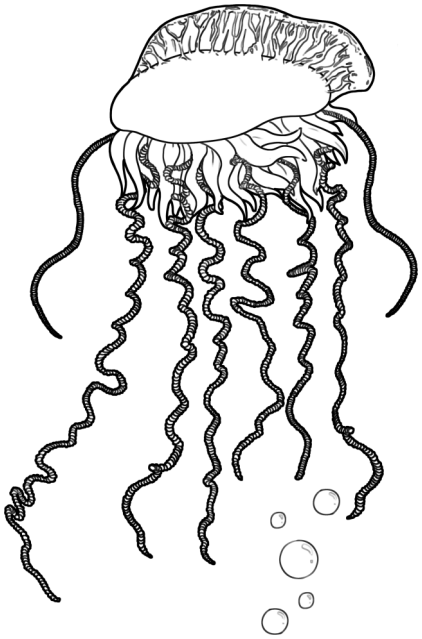
Conch



The **horseshoe crab** got its name because its hard shell is shaped a little like a horse's hoof. Some horseshoe crabs live along the eastern coast of the United States and Mexico, while others live in the waters of the Philippines and Southeast Asia. It has six pairs of legs and several pairs of eyes.

Horseshoe crab

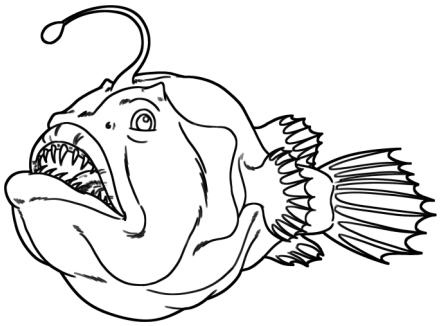
The **Portuguese man-of-war** is a beautiful and dangerous type of jellyfish that lives in warm waters all over the world, most often in the Gulf Stream of the Atlantic Ocean and in the tropical and subtropical parts of the Indian and Pacific oceans. It has a crest on the top of its body it can use like a sail. Underneath its jelly-like body are groups of body parts called polyps. Polyps do many different jobs, including eating.



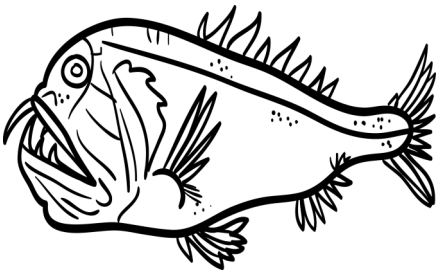
Hanging down from the polyps are the man-of-war's tentacles that can grow up to 165 feet (50 meters) long. That is higher than 15-story building! These tentacles have stinging cells that cause a lot of pain to a person or animal when it stings them and can be extremely dangerous.

Portuguese man-of-war

The **anglerfish** has a unique way of hunting for food. It "fishes" for them using a spine on its head like a fishing rod. There is a small piece of skin on the end of the spine that glows. The anglerfish moves it back and forth, using it like a lure to draw fish and small shrimp into its large mouth, full of sharp teeth. Though the anglerfish looks rather scary, it's a small fish only interested in eating other small fish.



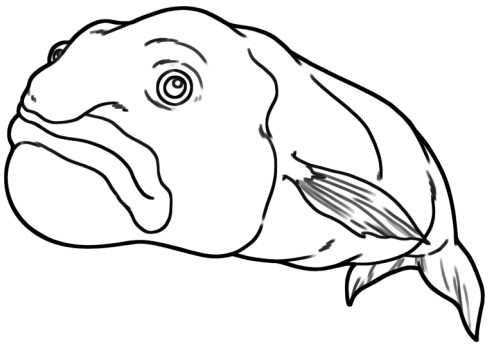
Anglerfish



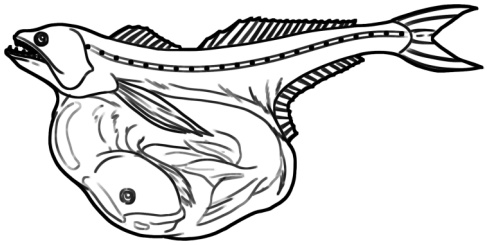
Like the anglerfish, the **fangtooth** looks incredibly scary but is really just a small fish. It is usually no more than 6 inches (15 centimeters) long. It is covered in scales and has very small eyes and poor eyesight. It senses movement in the water in order to find its prey. Its large teeth fit into special pockets in its mouth.

Fangtooth

The **blobfish** is a unique creature shaped just as its name suggests—like a blob. It has very soft bones and no scales. It doesn't swim very well but usually floats slowly along. It eats sea slugs and worms, which move slower than it does. Some of the creatures it eats give off light through bioluminescence. The blobfish's stomach is covered with dark tissue to keep the light from shining through to the dark waters outside and giving away the fish's position to its predators.



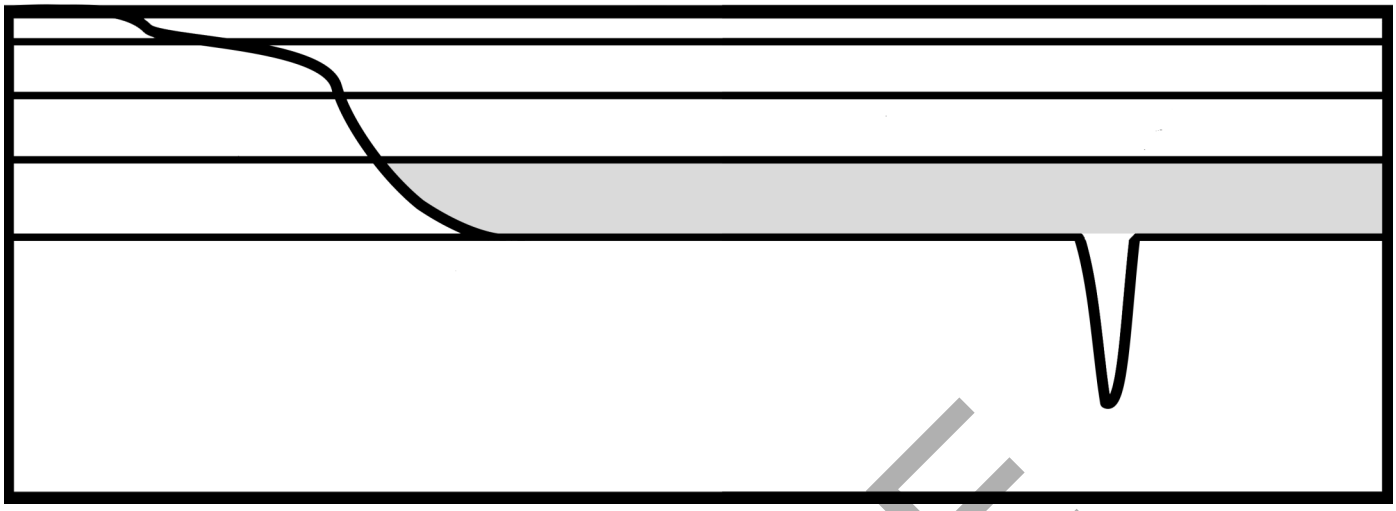
Blobfish



The **black swallower** is known for its rather strange stomach. Its stomach can stretch and grow many times larger than normal so the black swallower can actually eat and digest animals bigger than it is.

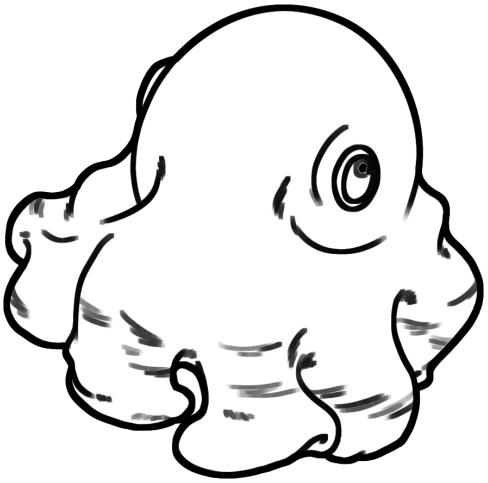
Black swallower

Abyssal Zone

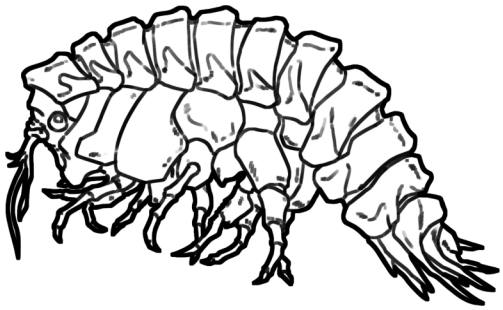


The name for the **abyssal zone** comes from a Greek word that means "no bottom." It's almost as deep as you can go, but not quite. It reaches from 13,000 feet to 19,686 feet (4,000 to 6,000 meters). There is no light here, and it takes a very special creature to be able to survive the near-freezing temperatures and incredible pressure. Let's see if we can meet a few of them.

Like other octopus and squid, the **dumbo octopus** is part of a group of animals called cephalopods, but the dumbo octopus lives the deepest of them all. It has eight arms, and each arm has a row of suckers and thin projections called *cirri*. The octopus uses its arms to bring food to its mouth, which is on the underside of its head. The dumbo octopus can be more than 6 feet (1.8 meters) long and sometimes can grow up to 13 feet (4 meters) long.



Dumbo octopus



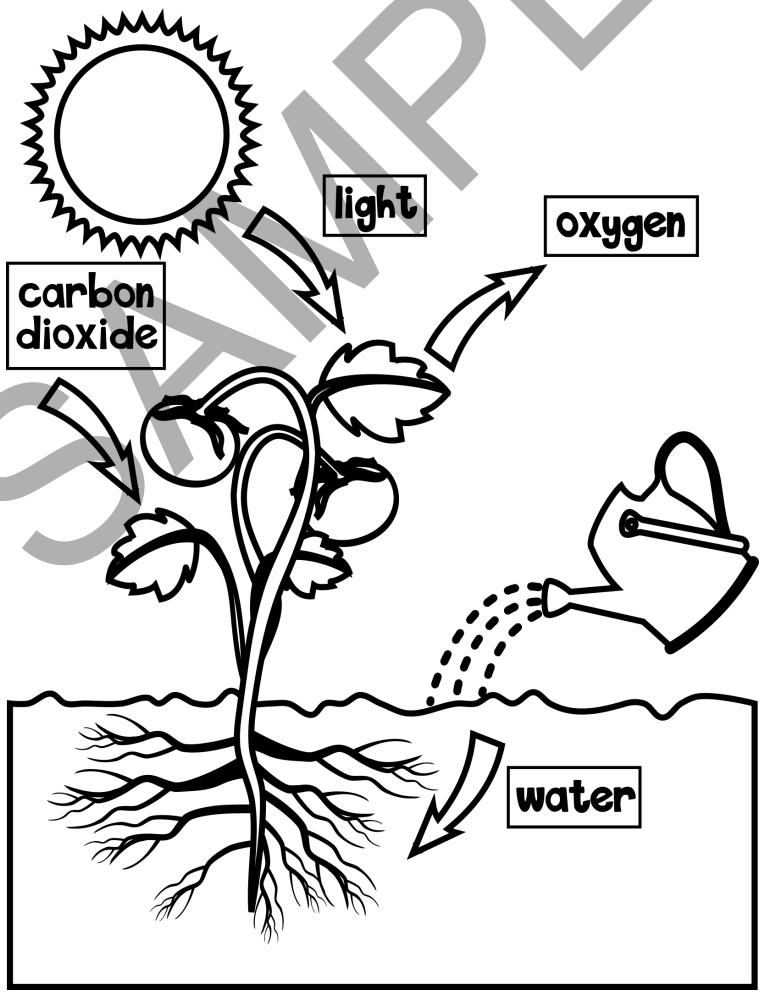
Amphipod

An **amphipod** is a crustacean and looks a lot like a shrimp. There are more than 1,000 different kinds of amphipods. Some live in the upper zones of the ocean or even on the beach, while others can live in the midnight or abyssal zones. Most are less than 1 inch (1 to 2 centimeters) long. They get their name from the Latin word *amphipod*, which means "different feet." Their front legs are positioned and shaped differently than their rear legs.

What's Going On Inside Plants?

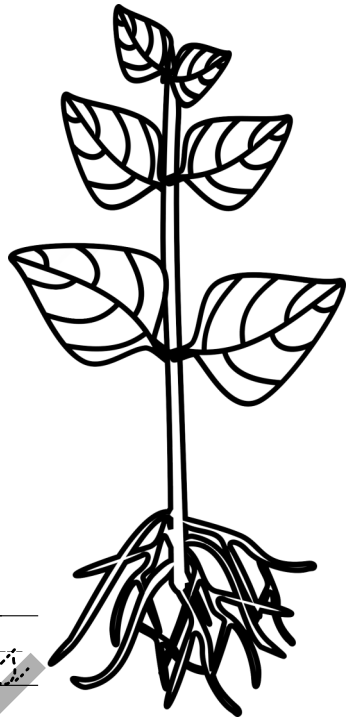
Where do we get our food? I don't mean which grocery store or anything like that, but what do people do to get the energy we need to live? We eat certain types of plants and animals that are safe and good for us to eat, and we make thousands of different foods from combining them with each other, everything from a cheese sandwich to all the choices you find at an all-you-can-eat buffet! We know that animals get their food by eating plants or other animals. But where do plants get their food? They can't get up and hunt it down. They can't go to the store. As a matter of fact, they don't even have mouths to use to eat their food if they could do one of those things.

Plants make the food they need for energy, and they do it using a process called **photosynthesis**, which means "putting together with light." Just like we put ingredients together to make something to eat, plants put the energy from sunlight together with water and a gas called carbon dioxide to make their food. Let's take a closer look at what happens.

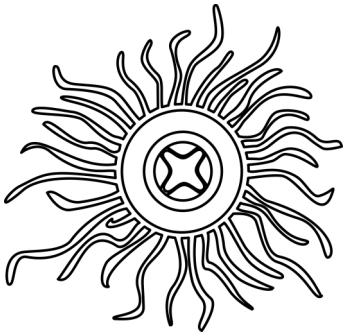


Photosynthesis

You're probably wondering what makes up the highway of tissues vascular plants use to transport all the water and nutrients the plant needs to stay healthy. These tissues are called **vascular tissues**. Let's see what we can discover about how they work together.



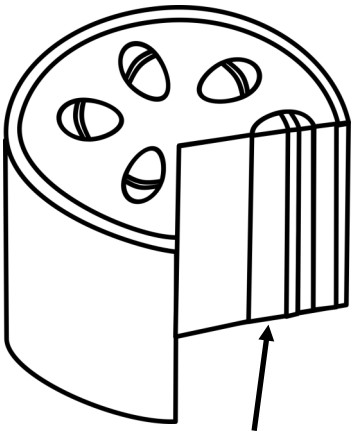
Vascular tissues



If you take a closer look at the roots of a vascular plant, you'll see they are actually covered with tiny **root hairs**. These root hairs start the process by absorbing water and minerals from the soil. As they do this, it creates pressure inside the plant.

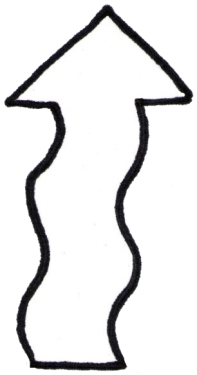
Root hairs

The water and minerals combined are called sap. The sap passes into tissues inside the stem called the **xylem**. The pressure inside the plant pushes the sap up through the xylem, but there's a problem. There isn't enough pressure to get the water all the way up to the leaves, and plants don't have a heart to pump what they need through their systems like people do. They need something to pull on the sap from the top of the plant to help it get the whole way up. That pull comes from another process called transpiration.



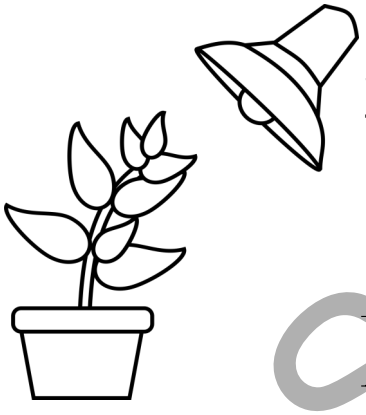
Xylem

Have you ever noticed that some plants grow straight up, nice and tall, while other plants twist and vine around things like your porch or maybe a piece of wood you put in the garden next to the plant? Sometimes, plants even seem to be able to move because they lean one way at one time of the day and the other way later in the day. We know plants can't move because their roots hold them to the ground. So what causes this "movement," and why don't all plants "move" the same way? To find the answer, we're going to need to understand something called **tropism**.



Tropism

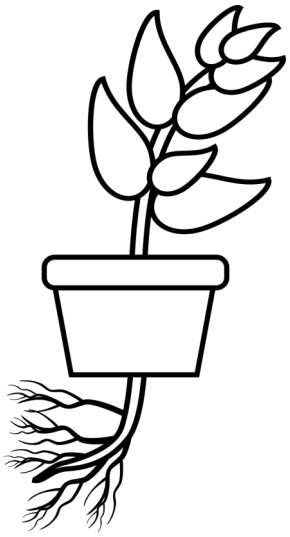
Tropism is an involuntary way a living thing moves as a reaction to something that happens outside the plant. Because it's involuntary, it means it happens without the plant being able to control it. The plant doesn't have to "think" about moving, it just moves as a response to whatever happened. There are different types of things that happen outside of plants that cause them to move in different ways. Let's find out the names of some of the ways plants "move."



Some plants move toward the light. If you put one in a window, it will lean toward the light. Why would it do that? The plant needs the energy from the sunlight to make photosynthesis happen. This moving toward the light is called **phototropism**.

Phototropism

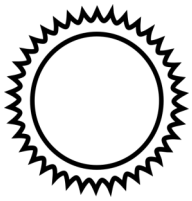
Did you know if you plant a seed or bulb upside down, its roots will still grow down? Plant roots have to go deep into the soil if they are going to absorb the water and minerals the plant needs to grow, so roots always grow toward gravity. This kind of growth is called **geotropism**.



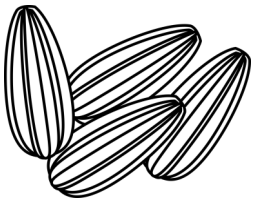
Geotropism

Review

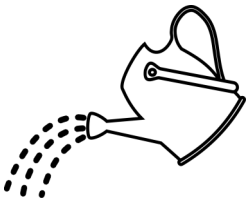
Which of the following is not an ingredient in photosynthesis? Draw an X through it.



Sunlight



Seeds



Water

What is the name of the simple sugar created by photosynthesis? Draw a circle around it.

Glucose

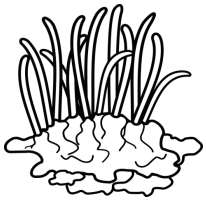
Oxygen

Carbon dioxide

Which of the following is not a vascular plant? Draw an X through it.

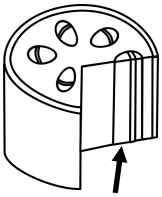
Dandelion

Grass

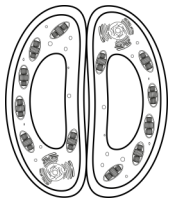


Hornwort

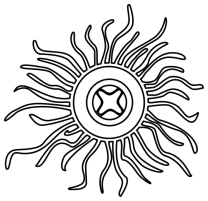
Which part of a plant soaks up water and minerals from the soil? Draw a circle around it.



Xylem



Stomata



Root hairs