Interactive Text
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### Living Things Need Energy

**Vocabulary**

- **photosynthesis**: the way plants use sunlight to make food.
- **consumer**: a living thing that eats other living things.
- **environment**: everything that surrounds a living thing.
- **decomposer**: a living thing that breaks down dead plants and animals.
- **food chain**: the path of energy in the form of food going from one living thing to another.
- **producer**: any living thing that makes, or produces, its own food.
- **herbivore**: an animal that eats mostly plants.
- **carnivore**: an animal that eats other animals.
**The Big Idea**

How do living things get energy to live and grow?

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>omnivore</td>
<td>an animal that eats both plants and animals</td>
</tr>
<tr>
<td>food web</td>
<td>a way of showing how food chains in any place are linked together</td>
</tr>
<tr>
<td>compete</td>
<td>to try to get the same thing that others need or want</td>
</tr>
<tr>
<td>microorganism</td>
<td>any kind of living thing that is too small to be seen with just our eyes</td>
</tr>
<tr>
<td>bacteria</td>
<td>any of the smallest kinds of microorganism</td>
</tr>
<tr>
<td>protist</td>
<td>a kind of microorganism larger than bacteria</td>
</tr>
<tr>
<td>fungus</td>
<td>a plantlike living thing that breaks down dead plants and animals</td>
</tr>
</tbody>
</table>
Lesson 1
Plants and Sunlight

What are plants?

Plants are living things. They are important for life on Earth. For example, plants make food. The food we eat all starts out from plants. Plants also make oxygen (OK•suh•juhn). Oxygen is a gas we breathe. Plants give off oxygen into the air.

Plants come in many shapes, sizes and colors. For example, trees, grasses, and bushes are different kinds of plants. However, most plants have three parts. They have roots, stems, and leaves.

Quick Check

1. What do plants make?

2. What are three parts that most plants share?

Leaves collect light from the Sun. They use the light to make food.

Stems hold a plant up. Water and other materials move through a stem. They may go up to the leaves or down to the roots.

Roots hold a plant to the ground. They take in water and minerals from the soil.
Here are some plants that hold world records. Some of them are natives of California.

Redwoods are the world's tallest plants. They grow in California. Some are over 100 meters (327 feet) tall. Some are over 2,000 years old.

Bamboo plants are the fastest growing plants. Some bamboo plants grow more than 2 centimeters (about 1 inch) an hour.

The oldest trees are the bristlecone pines. They live in California's White Mountains. One bristlecone pine is almost 5,000 years old.

Quick Check

3. Which of these amazing plants live in California? Why are they amazing? ____________________________

______________________________
How do plants get energy?

Most plants carry out photosynthesis (foh•toh•SIN•thuh•suhs). Photosynthesis is the way plants make their own food. To make food, plants need:

• sunlight
• water
• a gas (carbon dioxide)

The food plants make is sugar. The sugar has energy in it. Plants need the energy to live and grow. When we eat plants, we get that energy.

Getting Sunlight

Plants look green because they contain a green material, chlorophyll (KLAWR•uh•fil). Chlorophyll traps sunlight, energy from the Sun. A plant uses the energy to make sugar. The sugar is made in their leaves.

Reading Diagrams

Follow the arrows to see how a plant takes in sunlight, water, and carbon dioxide and give off oxygen.
Getting Water and Carbon Dioxide

Plants get water from the ground. Most plants you know have roots to take in water. Once inside the roots, water travels up through thin tubes:
- from the roots, water goes up the stem
- from the stem, water goes into leaves

Carbon dioxide is a gas in the air. Plants have tiny holes to take in this gas. These holes are the stomata (STOH•muh•tuh). They are on the bottom of each leaf. Carbon dioxide enters a leaf through the stomata.

Quick Check

Write the letter of the word that fits each statement.

4. _____ Plants get this from the Sun.  a. chlorophyll
5. _____ Plants make this food.  b. energy
6. _____ A green material in plants  c. sugar

How are roots and leaves alike? How are they different?

<table>
<thead>
<tr>
<th>Roots (different)</th>
<th>Alike</th>
<th>Leaves (different)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>8.</td>
<td>9.</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Why are plants important?

Remember, the energy for living things comes from the Sun. Plants can trap this energy. Plants use this energy to make food and oxygen. Food and oxygen are important to animals.

**Food**

Animals need energy to live. They get energy from food. Animals cannot make their own food. They eat food that comes from plants. Here’s how:

<table>
<thead>
<tr>
<th>How Food Is Passed</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants make their own food.</td>
<td>A leaf makes food.</td>
</tr>
<tr>
<td>Some animals eat plants for food.</td>
<td>A grasshopper eats the leaf.</td>
</tr>
<tr>
<td>Some animals eat the animals that eat plants.</td>
<td>A bird eats the grasshopper.</td>
</tr>
</tbody>
</table>

With the food, energy goes from plant to animal to animal.

**Quick Check**

Label each *True* or *False*. If it is false, correct it.

10. Animals can make their own food. ________________________________

11. Animals need energy to live. ________________________________
Oxygen

Plants make oxygen for themselves and other living things. Animals need oxygen, but cannot make it. Most animals cannot live without oxygen for more than just a few minutes.

Plants Everywhere

Plants live in environments all over Earth. An environment is everything that surrounds a living thing. Plants live in all kinds of environments from deserts to oceans. Plants provide energy in food for the living things around them.

Quick Check

Complete this sentence.

12. Animals need plants because ____________________________

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What is a food chain?

Living things get energy from food. A food chain is the path energy takes in the form of food going from one living thing to another.

Here’s the path of a food chain:

• The chain starts with energy from the Sun. A plant uses the energy to make its own food. The plant in a food chain is a producer because it makes, or produces, its own food.
• Next, an animal such as an insect eats the plant. Energy from the plant passes to the insect. Then another animal, such as a bird, eats that insect. So energy passes from the insect to the bird.
The insect and the bird are consumers. An animal is a **consumer** because it must eat, or consume, plants or other animals for food.

- Another consumer, such as a wolf, may eat the bird. The chain continues until consumers die.
- At the end of the chain are decomposers. **Decomposers** are tiny living things that break down dead plants and animals. That is, they make dead plants and animals rot. Then they return materials from the dead plants and animals to the soil. Worms and many insects are examples of decomposers.

**Quick Check**

Show the order of living things in a food chain.

13. ____________

14. ____________

**Reading Diagrams**

Arrows show the path of energy from the Sun to each living thing in the food chain.

A gopher eats the mustard plant.

A weasel eats the gopher.

A mountain lion eats the weasel.

When the mountain lion dies, decomposers break down its body.
What are herbivores?

In a food chain, the first consumer is an animal that eats a plant. For example, a gopher is a plant eater. A gopher is a herbivore (HUR•buh•vawr). A herbivore is an animal that eats mostly plants.

Deer, rabbits, grasshoppers, squirrels, and cows are herbivores. Herbivores are food for other animals. The word for an animal that is hunted by another animal for food is prey. All the animals here are prey for some larger or stronger animal.

Quick Check

15. How do herbivores get energy? ____________________________

Antelopes are herbivores. They are also prey to many other animals, such as lions.

The African elephant is Earth’s largest land animal. It is a herbivore that eats mostly grasses. It eats from 100 to 200 kilograms (220 to 440 pounds) a day.
What are carnivores and omnivores?

Lions and hawks eat other animals. They are carnivores. A carnivore (KAR•nuh•vawr) is an animal that eats other animals.

Some animals eat plants and animals. For example, a bear eats berries, leaves, mice, and squirrels. A bear is an omnivore (AHM•nuh•vawr). An omnivore is an animal that eats plants and animals. Raccoons and wasps are omnivores. People are omnivores.

Some animals hunt the animals they eat. Animals that hunt other animals for food are predators.

Quick Check

Write the letter of the food for each kind of animal.

16. _____ herbivore                  a. mostly animals
17. _____ carnivore                  b. plants and animals
18. _____ omnivore                  c. mostly plants
What are decomposers?

Decomposers are living things at the end of a food chain. They break down plants and animals that have died. The once-living material becomes part of the soil. This material helps other plants to grow. Then food chains can start all over.

There are many kinds of decomposers. Earthworms are decomposers. Insects, such as flies and beetles, are decomposers.

These earthworms are eating dead plants. They pass materials from the dead plants to the soil.

Quick Check

19. What job do decomposers have in a food chain?
More Food Chains

Here is a food chain in a pond. The producers in this pond are algae (AL•jee). Algae are living things that look like tiny plants. They float at the top of a pond or stream or ocean.

Follow the food chain:
1. Sunlight is trapped by algae. Algae make food.
2. Algae are eaten by mayflies.
3. Mayflies are eaten by sunfish.
4. Sunfish are eaten by herons.
5. Decomposers breakdown the herons when they die.

Quick Check

Fill in the blanks to show the path of energy in the pond food chain.

The Sun → 20. __________ → mayfly → 21. __________ →

22. __________ → decomposers

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What is a food web?

Many food chains are going on at the same time in any place. Follow the arrows in the picture. You’ll find many food chains.

The picture shows a food web. A food web shows how food chains are linked together in an environment.

Food chains are linked when any one animal belongs to more than one food chain. For example, the mouse belongs to two food chains:

- plant → mouse → snake
- plant → mouse → coyote

Food Web
Food chains show how different living things compete. When living things **compete**, they try to get the same thing, such as food. For example:

- both snakes and coyotes eat mice
- both mice and rabbits eat grass.

**Quick Check**

23. Two animals that the hawk eats are (a) ________________ and (b) ________________.

Two animals that can eat the mouse are (c) ________________ and (d) ________________.

---

**Reading Diagrams**

The arrows show the path of energy. For example, energy from a leaf goes to the small bird when the bird eats the leaf. The hawk gets energy when it eats the small bird.
How can food webs change?

Look at the kelp forest food web. Try to find as many food chains as you can. Start with the kelp in the lower left corner. Kelp is a kind of seaweed. Kelp grows in underwater forests. Many kinds of living things eat the kelp.

For example, here are just three food chains. They all start with kelp:

1. kelp → sea urchins → sea otters
2. kelp → sea cucumbers → crabs → sea otters
3. kelp → mussels → crabs → sea otters

Reading Diagrams

Put your finger on any one living thing. Follow the arrows point to and away from that living thing to see how it is part of different food chains.
A change in one kind of living thing in a food web causes other kinds of living things to change. For example, over 200 years ago, sea otters were hunted for their fur. So there were fewer and fewer sea otters in the food web.

Look at the kelp forest food web. Sea otters eat sea urchins. Without sea otters, fewer sea urchins were being eaten.

\[ \text{kelp} \rightarrow \text{sea urchins} \rightarrow \text{sea otters} \]

Soon there were too many sea urchins in the kelp forest. They were eating up the kelp. Other living things, such as mussels, could not get the kelp they needed. The mussels began to die out. Then crabs, which eat mussels, began to die out as well.

Many ocean animals eat kelp.

**Quick Check**

Complete these food chains. Use the kelp forest food web on p. 16.

\[ \text{kelp} \rightarrow \text{mussels} \rightarrow 24.(a) \text{ _________} \rightarrow \text{sea otters} \]

\[ \text{kelp} \rightarrow \text{sea cucumbers} \rightarrow \text{sea stars} \rightarrow 24.(b) \text{ _________} \]
How do new organisms change food webs?

A food web can change when a living thing is added to a place. For example, in Australia, over 70 years ago, insects were eating sugar cane plants. Farmers brought in large toads to eat the insects and save the sugar cane.

The farmers hoped that lizards and birds would eat the some of the toads. They wanted to keep the number of toads from growing.

However, the toads did not eat the insects. They ate the birds and lizards instead! The toads grew in number. They ate just about everything they could, even pets. What’s more, the insects kept eating the sugar cane.

The cane toad was brought in to eat insects. Instead, they ate just about everything else. They are still a problem today.

Quick Check

25. Why did farmers bring large toads to Australia over 70 years ago?
How does energy flow in a food web?

This diagram is a summary of what happens to the energy in a food web. The bottom of the diagram shows a producer—grass. Remember, producers get energy from the Sun. Producers make up the biggest part of the diagram.

The other levels are all consumers. Energy is passed to each level on top when the animal eats the food below it. The levels get smaller as you go to the top. Many producers are needed for the energy of just one living thing at the top.

Quick Check

Fill in the blanks to the food chain in this diagram.

grasses → 26. _______ → 27. _______ → hawk

Reading Diagrams

Fewer and fewer living things are in each layer as you look from bottom to top. The more powerful consumers are higher up in the diagram.

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What is a microorganism?

You cannot see them, but there are tiny living things everywhere. They live on food. They live inside and on the outside of your body. They live in ponds, lakes, and oceans. They live in soil. They live on dust in the air.

Tiny living things too small to be seen with just our eyes are called microorganisms (migh-kroh-guh-niz-uhms). You need a microscope to see them. Microscopes let you see things much bigger than they really are. With a microscope, you can find microorganisms in a drop of pond water.
Among the smallest kinds of microorganisms are **bacteria** (bak•TEER•ee•uh). Some bacteria are helpful. For example, some help your body break down food that you eat. However, some bacteria cause disease.

**Protists** (PROH•tists) are microorganisms that are a little larger than bacteria. Some protists help you. They eat harmful bacteria. Other protists can cause disease.

Your body is protected against microorganisms that cause disease. You can help keep your body stay safe from them. For example, wash and cover a cut to keep harmful bacteria out of your body.

### Stay Safe from Disease

<table>
<thead>
<tr>
<th>disease</th>
<th>cause</th>
<th>how you can help</th>
</tr>
</thead>
<tbody>
<tr>
<td>tooth decay</td>
<td>bacteria</td>
<td>brush and floss teeth</td>
</tr>
<tr>
<td>Lyme disease</td>
<td>bacteria in ticks</td>
<td>wear long pants on hikes</td>
</tr>
</tbody>
</table>

### Quick Check

28. How are bacteria and protists alike? ______________________

                                                  ______________________
                                                  ______________________
                                                  ______________________

29. How are bacteria and protists different? ________________

                                                  ______________________
                                                  ______________________
                                                  ______________________
Which microorganisms are producers and consumers?

Some microorganisms act like plants. Some act like animals.

Producers

Plants are producers. Remember, producers are the first step in a food chain. They take in energy from the Sun and make their own food. They also give off oxygen to the air.

Some microorganisms are producers. For example, algae (AL•jee) are producers that grow in large numbers at the top of ponds, lakes, and the ocean. Algae are important because they make much of the oxygen for living things.

Algae and other tiny producers act like plants, but they are not plants. They do not have the parts plants have. They do not have roots, stems, and leaves.

▲ These algae are seen under a microscope. Unlike plants, they have no roots, stems, and leaves. However, they do make food and oxygen.
Consumers

Remember, animals cannot make their own food. Animals are consumers. They move about to get food.

Some microorganisms act like animals. For example, an amoeba (uh•MEE•buh) is a protist. It acts like an animal. It moves its body to get food. It can wrap around the food to catch it.

The body of an amoeba flows in different directions. The body seems to reach out toward food. The body can flow around the food.

Producers and Consumers

*Euglena* (yew•GLEE•nuh) is a protist that lives in ponds. It acts like a plant and like an animal. In sunlight, it can make its own food—like a plant. It can also move around to get food—like an animal.

Euglena has a body part that looks like a tail. It whips this part as it moves.

Quick Check

Complete this main idea chart.

<table>
<thead>
<tr>
<th>Main Idea</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiny living things can act like plants or animals, or both.</td>
<td>Some can make food, like plants.</td>
</tr>
<tr>
<td></td>
<td>30.</td>
</tr>
</tbody>
</table>
Which microorganisms are decomposers?

Remember, decomposers are the last step in a food chain. They break down dead plants and animals. The diagram shows three decomposers on a dead tree. One is a large living thing, the mushroom. The two other decomposers are microorganisms. They are mold and bacteria.

A mushroom is a fungus (FUNG•guhs). A fungus is a living thing that may look like a plant. However, a fungus does not make its own food as plants do. It gets food by feeding off a dead thing.
The diagram on page 24 shows two other decomposers: mold and bacteria. Both are microorganisms. Mold is a type of fungus. A single mold is too small to see. However, you can see mold growing in large numbers on dead wood and other once-living things. They make the once-living things rot.

Bacteria are much smaller than mold. You can see them only with a microscope. There may be billions of bacteria in just a teaspoonful of soil. Many bacteria in soil are decomposers.

When the tree is broken down, it becomes part of the soil. The soil is then ready for new plants to grow.

Quick Check
List the three decomposers in order from largest to smallest.

31. 

32. 

33. 

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Living Things Need Energy

Choose the letter of the best answer.

1. One way to show how food chains in any place are linked together is to draw a(n)
   a. photosynthesis
   b. living thing
   c. food web
   d. producer

2. Microorganisms that are larger than bacteria are
   a. protists
   b. fungus
   c. producers
   d. consumers

3. An animal that eats both plants and animals is a(n)
   a. bacteria
   b. decomposer
   c. herbivore
   d. omnivore

4. Any living thing that makes its own food is a(n)
   a. producer
   b. protist
   c. bacteria
   d. fungus

5. Everything that surrounds a living thing is called a(n)
   a. food chain
   b. competition
   c. food web
   d. environment

6. When animals try to get the same thing that others need or want, they
   a. produce
   b. eat
   c. compete
   d. surround

7. The way plants use sunlight to make food is called
   a. decomposer
   b. photosynthesis
   c. omnivore
   d. food chain
Use each word just once to fill in the blanks.

1. A living thing that breaks down dead plants and animals is called a(n) _________________.

2. An animal that eats mostly plants is a(n) _____________________.

3. The smallest of the microorganisms is _____________________.

4. An animal that eats other animals is called a(n) _____________________.

5. The path of energy in the form of food from one to another is called the _____________________.

6. A plantlike living thing that breaks down dead plants and animals is _____________________.

7. A living thing that eats other living things is a(n) _____________________.

Living Things and Their Environment

Vocabulary

**ecosystem** all the living and nonliving things working together in an area

**pollen** a powdery material that flowers need to make seeds

**climate** the kind of weather an area has over time

**stamen** the part of a plant where pollen comes from

**emergent layer** the tops of trees in a rain forest

**pistil** the part of a plant where seeds are made

**canopy** the layer just under the tops of the trees in a rain forest, where most plants and animals live

**pollination** the movement of pollen to the seed-making part of a flower
How do living things depend on one another and the environment?

- **nectar**: a sweet liquid formed inside flowers
- **endangered**: few left of this kind of living thing
- **extinct**: none of this kind of living thing left alive today
- **adaptation**: a body feature or way of acting that helps a living thing survive in its environment
- **camouflage**: how a living thing might not be seen because it blends into its surroundings
- **mimicry**: how an animal may look like some kind of other living thing
What is an ecosystem?

Plants grow from the soil. They need water to grow. Some birds use plants to make nests. Some animals eat plants. Tiny living things, bacteria, may break down dead plants. These are ways plants, animals, bacteria, soil, and water interact. *Interact* means “one thing uses or needs another.”

All the parts interacting in any place make up an ecosystem (EK•oh•sis•tuhm). Some parts may be living. For example, plants are living. Some parts, such as water, are nonliving.

**Pond Ecosystem**

1. Many plants find space to live along the water’s edge. They get water and nutrients from the soil.
2. Birds use pond plants to make their nests.
3. Frogs eat the insects they find around the pond.
4. Turtles come to the water’s surface to get air and to feel warmth from the Sun.
### Living Things | Nonliving Things
--- | ---
- animals—such as birds, frogs, turtles, fishes, crayfish, insects, earthworms  |  - sunlight
- plants—such as lily pads on the water, cattails on the shore  |  - air
- tiny living things—such as algae and bacteria  |  - water

**Climate** (KLIGH•mit) **Climate** is the kind of weather an area has over time. The climate is the temperature and the amount of rain and snow the area has.

### Quick Check

1. Cross out any part that is not a living part of a pond.
   - duck  catfish  beetle  water  sunlight  frogs  air

2. List two more parts of a pond. __________________________

### Reading Diagrams

Each number in the diagram has a matching statement at the left that tells how living and nonliving things interact.
What is a desert ecosystem?

All deserts are dry. They get little rain. Some deserts are hot. Others are cold. Some deserts are almost lifeless. Some have many living things. Living things of the deserts have ways of surviving the little water and the hot or cold temperatures.

California’s Mojave Desert is dry and hot. It gets about 13 centimeters (5 inches) of rain a year. Many plants and animals can live here.

The fennec fox lives without water for a long time. It stays underground in the day and looks for food at night when it is cool.

The desert tortoise spends much of the time underground. That keeps it safe when temperatures change from day to night.

Quick Check

3. How can deserts be different? ________________________________
What is a coral reef ecosystem?

Coral reefs are warm ecosystems. They are found in shallow water. Their temperatures stay warm all year, from 70 to 85°F (21 to 29°C). The warm temperatures allow many ocean animals to live here.

The reefs were made from the parts of tiny animals, coral polyps (POL•ips). After the animals die, their skeletons are left behind. The skeletons form the reefs.

Fishes swim across the reef. Many colorful sea animals grow attached to the reef. They may look like plants, but they are animals.

Quick Check

Show how deserts and coral reefs are alike and different.

<table>
<thead>
<tr>
<th>Coral Reefs (different)</th>
<th>Alike</th>
<th>Deserts (different)</th>
</tr>
</thead>
<tbody>
<tr>
<td>are wet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Both are

5. ____________________

_____________________

_____________________
What is a rain-forest ecosystem like?

Rain forests are hot and wet. They can get up to 457 centimeters (180 inches) of rain a year. Compare that to only 13 centimeters (5 inches) of rain a year in the Mojave Desert.

Although the soil is thin, these forests are thick with tall trees. Rain forests are filled with many kinds of life. Different living things make their homes at all parts of the trees, from the tops to the bottom.

▲ The rain forest is made of different layers, from the sunny tops to the shady bottom.
Layers of the Rain Forest

<table>
<thead>
<tr>
<th>layer</th>
<th>location</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>emergent layer</td>
<td>tops of tallest trees</td>
<td>• very sunny</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• high temperatures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• strong winds</td>
</tr>
<tr>
<td>canopy</td>
<td>just below the tree tops</td>
<td>• sunny</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• most crowded with life, including snakes, tree frogs, and toucans</td>
</tr>
<tr>
<td>understory</td>
<td>beneath the canopy</td>
<td>• shady</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• home of jaguars, leopards, frogs and many insects</td>
</tr>
<tr>
<td>forest floor</td>
<td>bottom of the trees</td>
<td>• dark, little sunlight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• filled with decomposers—living things that break down dead plants and animals</td>
</tr>
</tbody>
</table>

The forest floor is filled with dead leaves and other once-living things. Decomposers work quickly breaking them down and returning the remains to the soil.

Quick Check

Write the letter of the living things for each layer.

6. _____ canopy          a. decomposers
7. _____ understory      b. snakes, toucans
8. _____ forest floor    c. leopards
How do animals depend on plants?

Plants can trap energy from the Sun. They use that energy to make their own food. As they make food, they also give off oxygen.

Plants as Food

Animals cannot make their own food. One way or another, animals depend on plants for food. They also depend on plants for oxygen.

Some animals eat plants directly. For example, rabbits eat leaves. Some beetles eat roots and stems. Monkeys and birds eat fruits and seeds. Snails and earthworms feed off dead plants.

Some animals are meat eaters. However, even meat eaters depend on plants because they may eat animals that are plant eaters.

▲ Squirrels use nuts for food. The nuts are seeds, parts of plants.

▲ Caterpillars eat leaves as a source of food energy.
Plants as Shelter

Many animals depend on plants for shelter. Many squirrels, for example, may live in tree holes. They line the holes with leaves. Many birds build nests in trees. They use twigs and leaves for the nests. They use the nests to keep their young safe.

Many animals hide in plants to stay safe. For example, a rabbit jumps into bushes if danger is near. Leafhoppers hide in grass.

Grass as Protection

The color and shape of the snake blends the animal in with the grass.

Quick Check

Fill in one idea in each empty box to explain the summary.

9. ________________ oxygen ________________ 10. ________________

Summary: Animals depend on plants for three things.
How do some plants depend on animals?

Flowering plants make seeds when they reproduce. Animals can help the plants make seeds.

A flowering plant needs **pollen** (POL•uhn) to make seeds. Pollen is like a fine powder. The diagram shows what happens to pollen.

- Find the **stamen** (STAY•muhn) in the diagram. The stamen is the part of a flower that makes pollen. Pollen collects at the tip.
- Find the **pistil**. The pistil is where seeds are made.
- A flower can make a seed only if pollen reaches the pistil. The diagram shows one way pollen reaches a pistil.

**Pollination**

**Reading Diagrams**

What happens after the bird collects pollen on its body?

LOG ON Science in Motion Watch how pollination occurs @ www.macmillanmh.com
Pollination (POHL•uh•nay•shuhn) is the movement of pollen to the pistil. Wind can blow pollen from a stamen to a pistil.

Also, animals can move pollen:
• Birds, bats, and many insects travel from flower to flower. They collect a sweet drink from flowers called nectar (NEK•tar).
• When an animal visits a flower to collect nectar, pollen can rub onto its body.
• When the animal visits another flower, the pollen drops off.

Animals carry seeds to places where seeds can grow. Some animals carry seeds on their fur. In time the seeds fall onto the ground.

Plants store seeds inside fruits. Animals may eat a fruit that has seeds inside. The seeds are left on the ground when animals leave waste.

Quick Check
Fill in the blanks to tell two ways how plants depend on animals.

Animals can move 11. ___________________________ and carry 12. ___________________________.
How can ecosystems change?

Remember, an ecosystem is made up both of living and nonliving things working together. Living things, like plants, need nonliving things, like soil, water, and sunlight. When one part of an ecosystem changes, such as the amount of water, all parts of the ecosystem can change.

Ecosystems can change over time. They can become wetter or drier. They can become colder or warmer. A lake can dry up or fill in. Any kind of change can make it harder for living things to survive.

Lake Tahoe in California has changed slowly over thousands of years to look the way it does today. It also changes from season to season.
Natural Events
Changes in weather can affect ecosystems. Storms, like hurricanes, can destroy ecosystems. Lightning can start a fire and turn a forest to ash.

The climate may change. Climate is the weather over time. An area may become drier, for example. A grassland can dry up.

Humans
People can cut down forests to make farms or build towns. Entire ecosystems can be destroyed. People can cause pollution (pol•LEW•shuhn). Pollution means putting materials to the air, land, or water that can make it harder for plants and animals to live.

Quick Check
Two ways ecosystems can change are:

13. ___________________________________ and
14. ___________________________________.

▲ Cars give off wastes that causes pollution.
What happens when ecosystems change?

A fire destroys a forest. What happens to the living things that are left?

- Some living things change they way they live. They may find new kinds of food. They may find new ways to build homes.
- Some animals move to other places.
- Some kinds of animals may slowly die out.

A living thing that has few of its kind left is endangered (en•DAYN•juh·rd). A living thing is extinct (ek•STINGT) when it dies out and there are none of its kind left.

Quick Check

Fill in the “effect” side to tell two ways the deer can keep alive after a fire destroys their home.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>15. ________________</td>
</tr>
<tr>
<td>Fire</td>
<td>16. ________________</td>
</tr>
</tbody>
</table>
How can people protect ecosystems?

People are finding ways to protect ecosystems. For example they are finding ways to cut down on pollution. People are looking for new fuels and passing laws against polluting the land, water and air.

Laws are also being passed to protect forests from being cut down. Laws can protect animals from being hunted.

Quick Check

Fill in the right side of the table.

<table>
<thead>
<tr>
<th>Saving Ecosystems</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What Can I Do?</strong></td>
<td><strong>How It Helps</strong></td>
</tr>
<tr>
<td>Turn off water while brushing teeth.</td>
<td>to save water</td>
</tr>
<tr>
<td>Do not litter.</td>
<td>17.</td>
</tr>
<tr>
<td>Walk or ride a bike instead of riding a car.</td>
<td>18.</td>
</tr>
</tbody>
</table>

People had destroyed the homes of the California condor. Now people are carefully raising them in safe environments.

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What is an adaptation?

A giraffe’s long neck helps it reach high branches. A dolphin’s tail and fins help it swim quickly in the ocean. An eagle’s keen eyesight helps it spot food. These body features are adaptations (a•dap•TAY•shuhnz). Adaptations are body features or ways of acting that help living things survive in their environment.

Adaptations can help animals move and catch food. Adaptations can help animals and plants live in hot or cold climates.

A dragonfly’s wings help these insects fly fast so they can catch food and escape danger.

A giraffe’s long neck helps the animal reach leaves to eat. It also gives the animal a view of danger that may be coming, such as a lion.
Some adaptations help living things stay safe. **Camouflage** (KAM•uh•flahzh) is an adaptation that helps a living thing blend into its environment. For example, if a deer stays still against a brown background, it may not be seen.

Some animals hide by looking like other living things. This adaptation is **mimicry** (MIM•i•kree).

**Quick Check**

Two adaptations that help this eagle catch a fish are

19. ____________________________________

20. ____________________________________
Storing water

The barrel cactus has a thick, waxy skin and thick, round stem. These adaptations help it store water in its stem. The prickly spines keep animals from biting into the plant to get the water.

More Desert Plants

Creosote (KREE•oh•soht) bushes have shallow roots. These roots help the plant take in water from the little rain that falls.

Ocotillo (oh•koh•TEE•oh) plants drop their leaves during very dry times to keep from drying out. Leaves grow back after the next rainfall.
Desert animals have adaptations that help them survive with little water. In hot deserts, animals have adaptations to help them stay cool.

**More Desert Animals**

Many desert animals, including the great horned owl are active at night when it is cooler. They rest or sleep during the day.

The jackrabbit has very long, thin ears to help keep cool. The blood carries body heat into the ears. The blood loses heat as it flows through the ears.

**Quick Check**

Two living things that have adaptations for storing water are:

21. ___________________________  22. ___________________________

Two animals that have adaptations for surviving in heat are:

23. ___________________________  24. ___________________________
What are adaptations in the arctic and in oceans?

In the arctic and the oceans, living things have ways of surviving the most harsh conditions.

The Arctic

**polar bear**

**Skin and fur** The outer fur of a polar bear is waterproof. The thick inner fur keeps the bear warm. Black skin beneath the white fur helps the bear take in heat from the Sun.

**arctic fox**

**Camouflage** The arctic fox in winter has a white coat. The coat helps it blend in with the snow. In summer its coat is brown.

Other Arctic Animals and Plants

The large size of a musk ox and polar bear helps them to keep warm.

Arctic plants grow low near the ground. This adaptation protects them from the wind. They often have bright flowers. The colors attract animals that help in pollination.
The Oceans

whale

Blubber A whale has blubber, a thick layer of fat. Blubber helps keep a whale’s body warm in cold ocean water.

leafy seadragon

Mimicry The leafy seadragon is a kind of fish. However, it looks like the seaweed that surrounds it.

Quick Check

In “Alike,” list 2 animals from the arctic and the oceans that have a similar adaptation. In “Different,” list an arctic animal and an ocean animal that have different adaptations.

Arctic (different)  Alike  Ocean (different)

25. ______________________  26. ______________________  27. ______________________  28. ______________________

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Living Things and Their Environment

Fill the missing words in the blanks below. Then find and circle those words in the puzzle at the bottom.

1. The layer just under the tops of the trees in a rain forest, where most plants and animals live _________________

2. The part of a plant where seeds are made _________________

3. A sweet liquid formed inside flowers _________________

4. The kind of weather an area has over time _________________

5. A living thing that has died out and there are none of its kind left today _________________

6. A living thing that has few of its kind left _________________

7. The part of a plant that makes pollen _________________

T R C S C N Z D T M T U E M Y
M N E F E C G K J N M N X V P
C A E C Y O R X F D B Q T O O
S L T M R Z F Z O P T K I F N
U A I W A I Z L H U L N N Z A
R H L M G T Q C D E H I C E C
Y I B M A V S U S W A P T Q H
K M B E T T U F U W S S I C W
E N D A N G E R E D I V B T N
P T Z B Q V G B L I T S I P S
Match the correct letter with the description.

1. _____ The movement of pollen to the seed-making part of a flower

2. _____ The tops of trees in a rain forest

3. _____ How a living thing might not have been seen because it blends into its surroundings

4. _____ A powdery material that flowers need to make seeds

5. _____ All the living and nonliving things working together in an area

6. _____ How an animal might look like some kind of other living thing

7. _____ A body feature or way of acting that helps a living thing survive in its environment

Answer the question. Use at least one word from the box in your answer.

8. What are some ways that animals protect themselves?

__________________________________________________________
__________________________________________________________
__________________________________________________________
Rocks and Minerals

**Vocabulary**

- **mineral** one of the parts that a rock is made of
- **ore** a rock that contains a useful mineral
- **luster** the way something shines in the light
- **magma** hot, melted rock beneath Earth's surface
- **streak** the color of the powder made when a mineral is scratched on white tile
- **lava** magma that reaches Earth's surface
- **hardness** the ability of a mineral to scratch another mineral
- **igneous rock** a rock formed from hot, melted rock that cools and hardens
What are rocks and minerals and where do they come from?

<table>
<thead>
<tr>
<th><strong>sediment</strong></th>
<th>tiny broken bits of rocks, plants, bones, and shells</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sedimentary rock</strong></td>
<td>a rock formed from tiny pieces of broken rocks pressed together</td>
</tr>
<tr>
<td><strong>fossil</strong></td>
<td>the remains of a once living thing from long ago</td>
</tr>
<tr>
<td><strong>metamorphic rock</strong></td>
<td>a rock formed from another rock that is being squeezed and heated</td>
</tr>
<tr>
<td><strong>rock cycle</strong></td>
<td>the continual changing of one kind of rock into another kind</td>
</tr>
</tbody>
</table>
What is a mineral?

Pick up a rock—for example, a chunk of granite. You can see that it is made of small pieces of different colors and shapes.

The pieces in granite are minerals (MIN•uhr•uhlz). Minerals are the parts that rocks are made of. Minerals are the building blocks of rocks. Rocks may be made of many minerals or just one.

There are thousands of minerals. They have different shapes and colors. Here are the four minerals that make up granite.

---

**Minerals in Granite**

- **Mineral: Hornblende**
  - dark, black to green

- **Mineral: Mica**
  - brown, clear, or black
  - It peels into flakes

- **Mineral: Feldspar**
  - green to pink to blue

- **Mineral: Quartz**
  - many colors or colorless

---

**Quick Check**

1. How are minerals different?

2. How are minerals alike?

---

54
Rocks and Minerals
What are minerals used for?

People can take minerals out of rocks. Then we can use the minerals in many ways. From toothpaste to eyeglasses, minerals are used to make many things we use every day.

Many minerals that we use are from ores (AWRZ). Ores are rocks that contain useful minerals. The mineral aluminum for example comes from the ore bauxite (BAWK•sight). We use aluminum for cans, pots and pans, and even baseball bats.

Ways We Use Minerals

<table>
<thead>
<tr>
<th>mineral</th>
<th>uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>quartz</td>
<td>glass and glass products</td>
</tr>
<tr>
<td>gypsum</td>
<td>drywall (for making walls in building)</td>
</tr>
<tr>
<td>copper</td>
<td>electrical wires; pots and pans</td>
</tr>
</tbody>
</table>

Quick Check

3. Why are minerals important? ________________________________
How are minerals identified?

When you identify something, you are able to name it. How can you identify a mineral?

The color on the outside of a mineral is not the best clue to identify a mineral. Two different minerals can have the same color. For example, calcite and quartz can both be white. Any one mineral may come in many colors. Quartz can be white, purple, or pink.

Luster

Luster can help you identify minerals. Luster is the way something shines in the light. Some minerals have a shiny or metallic luster, like a metal spoon. Other minerals have a nonmetallic luster. They may be dull or glassy.

Splitting

Some minerals split, or break along flat surfaces. Calcite, for example, splits into boxlike shapes. Remember from page 54 that mica splits into flakes. Some minerals do not split evenly.

Calcite splits into boxlike shapes.

Some minerals, such as quartz, do not split along flat surfaces.

Pyrite (PIGH•right) was called “fool’s gold.” It has a yellow color and a metallic luster like gold.
Streak

A helpful clue to identify a mineral is its streak. **Streak** is the color of the powder left when a mineral is rubbed along a rough white tile. Some minerals leave a streak that is the same color of the mineral. Others leave a streak that does not look like the color of the mineral. Pyrite has a yellow color but leaves a greenish-black streak.

Quick Check

Match the clues with the letter of the mineral.

4. _____ black color, reddish streak  
   a. mica

5. _____ metallic luster, greenish-black streak  
   b. calcite

6. _____ splits into flakes  
   c. hematite

7. _____ splits in boxlike shapes  
   d. pyrite

Comparing Color and Streak

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Color of Outside of Mineral</th>
<th>Streak</th>
</tr>
</thead>
<tbody>
<tr>
<td>gold</td>
<td>yellow</td>
<td>yellow</td>
</tr>
<tr>
<td>pyrite</td>
<td>yellow</td>
<td>greenish-black</td>
</tr>
<tr>
<td>calcite</td>
<td>white or colorless</td>
<td>always white</td>
</tr>
</tbody>
</table>

Hematite has a black surface. However, it leaves a red streak.
What is hardness?

The hardness of a mineral can also help you identify it. **Hardness** is the ability of one mineral to scratch another mineral.

Each mineral has a hardness number. Look at the the chart. Talc is number 1, the softest. Diamond is number 10, the hardest.

A mineral can scratch any other mineral that has the same or a lower hardness number. For example, calcite, number 3, can scratch, any mineral with a hardness number that is 3 or less. Calcite can scratch gypsum and talc.

You can use everyday items to find the hardness of minerals. Your fingernail can scratch gypsum and talc. A penny can scratch calcite, gypsum, and talc.

---

**Hardness of 10 Minerals**

- **Talc** 1
- **Fingernail** 2.5
- **Penny** 3.0
- **Glass** 5.5
- **Steel file** 6.5
- **Diamond** 10

**Reading Charts**

A mineral or tool can scratch any mineral with the same or lower hardness number.
The table sums up the clues you can use to identify some minerals. For example, quartz and calcite may both be white. However, quartz is much harder than calcite.

**Quick Check**

Tell how mica and calcite are alike and different.

8. Mica can have a ________________ color and splits into ________________.

9. They both have a hardness of ________________ or less and have a nonmetallic ________________.

10. Calcite can have a ________________ color and splits into ________________.
How are igneous rocks formed?

The rocks you know are solids. However, deep below Earth’s surface, rock is very hot. It is melted into a liquid. Hot, melted rock below Earth’s surface is magma (MAG•muh). In some places, magma reaches the surface, as you see in the diagram. Magma that reaches the surface is lava (LA•vuh).

Above or even below the surface, the melted rock can cool off. When it cools off, it hardens into a solid, igneous (IG•nee•us) rock. Igneous rock is rock formed when hot, melted rock cools and hardens.
Underground Rocks

Magma can rise up from deep underground. It can cool off underground before it gets to the surface. The magma may take many years to cool off underground. It forms igneous rocks that have large pieces of minerals inside. Example:

- granite

Rocks Above Ground

Above Earth’s surface, lava cools off quickly, in hours or even minutes. The minerals inside the rock are small. They may be so small that you cannot see each of them. Example:

- rhyolite (RIGH•uh•light)

Quick Check

Write the name of a rock next to each description. Use each rock twice.

<table>
<thead>
<tr>
<th>rhyolite</th>
<th>granite</th>
</tr>
</thead>
</table>

11. forms underground ____________________
12. forms above ground ____________________
13. has small minerals inside ________________
14. has large minerals inside ________________

Reading Diagrams

How can you tell from the diagram that magma must be hot?

LOG ON Science in Motion Watch how igneous rocks form at www.macmillanmh.com
**What are some properties of igneous rocks?**

There are many different igneous rocks. They may have different minerals inside. The minerals are large pieces if the rock was formed underground. The minerals are small if the rock was formed above ground.

**Granite**
- formed underground
- is made of several different minerals
- has large minerals that make it feel rough (coarse)
- comes in many colors because of different colors of minerals inside

**Pumice (PUM•is)**
- formed above ground
- has tiny holes inside from trapped gases
- very lightweight
- feels scratchy, crumbly

**Obsidian (uhb•SID•ee•uhn)**
- formed above ground
- feels very smooth like glass
- has a glassy shine (luster)
- dark in color, often black
Uses of Igneous Rocks

Igneous rocks are useful in many ways because of their properties.
• Granite is hard and long lasting. It is used to make roads, sidewalks, buildings, and bridges.
• Pumice is scratchy and rough. It is used in cleansers to scrub off dirt.

Quick Check

Write the name of each rock once next to each description.

15. hard, used to make buildings ______________________
16. scratchy, used in cleansers ______________________
17. like shiny, smooth glass ______________________
How are sedimentary rocks formed?

Some rocks are formed from sediments (SED•uh•mentz). Sediments are tiny broken bits of rocks, plants, bones, shells, and other animal materials. Rocks formed when sediments are pressed together into layers are sedimentary rocks.

You can see the layers of sedimentary rocks along the Grand Canyon. The colors of these layers come from different kinds of sediments.
How Layers Form

Layers of sedimentary rocks form in three steps.
- Moving things (wind, rivers, and streams) pick up and carry sediment.
- The moving things drop off sediment and layers form.
- Layers build up, one on top of another. Layers above press down on the layers below. The sediment in the lower layers are cemented together. They become sedimentary rock.

In the sediment that forms in a sedimentary rock, there are often pieces of living things, such as leaves and bones. The remains of living things from long ago are fossils.

Layers of Sediments

A

B

C

D

Reading Diagrams

Younger layers are found above older layers.

Quick Check

Complete the diagram. With just a few words in each step, summarize how layers form.

First 18. __________________________________________________________________

Next Drop off; layers form.

Last 19. __________________________________________________________________

This fossil was found in sedimentary rock that was once underwater.
What are some properties of sedimentary rocks?

There are many different sedimentary rocks. They are made from different kinds and sizes of sediments. Some are softer than others. Some have layers. Some do not show layers. Many kinds contain fossils.

**Limestone**
- formed at bottoms of oceans
- formed from remains of once-living things, such as bones and shells
- usually white, chalky
- often has fossils

Limestone often contains fossils, such as this ancient fish.

**Sandstone**
- formed from bits of sand cemented together
- sand is made up of the mineral quartz
- may show ripples if it was formed underwater

This sample of sandstone is reddish from rust. The rust is cementing the sand together. You can see thin layers inside the rock.
Conglomerate (kuhn•GLOM•uhr•it)
• formed from rounded pebbles and stones, which may once have been carried by streams or rivers
• has several sizes and kinds of sediment
• looks chunky and feels rough

Uses of Sedimentary Rocks
Sedimentary rocks have useful properties.
• Limestone is soft. It is used to make chalk.
• Shale can be molded. It is used for bricks and pottery.
• Soft coal was formed from the remains of ancient plants. The energy stored in soft coal is from ancient plants.

Sedimentary rocks help us piece together Earth’s past. Fossils in these rocks show what life was like in the past.

Quick Check
20. How could you identify a piece of sandstone?

21. How could you identify a piece of conglomerate?
How are metamorphic rocks formed?

Below Earth's surface are many layers of rocks. Layers near the top press down on deeper layers. This pressing squeezes deeper layers together. Also, the deeper layers are heated by the hot magma that is nearby.

Deep inside Earth, rocks that are squeezed and heated can change into other rocks called **metamorphic** (met•uh•MAWR•fik) rocks. Metamorphic rocks can be formed from any kind of rocks.
Rocks Make-Overs

One metamorphic rock you may know is slate. Slate is a hard rock used to make chalkboards and roofs. It is formed from a soft sedimentary rock, shale. When shale is squeezed and heated deep inside Earth it becomes slate. Slate, in turn, can change into another metamorphic rock, schist (SHIST).

**Quick Check**

Fill in the boxes to show how metamorphic rocks are formed

Deeper rocks are squeezed by rocks above.

Deeper rocks are 22. ____________

Any rock can be changed into 23. ____________

**Summary**

Any rock can be changed into 23. ____________
What are the properties of some metamorphic rocks?

Metamorphic rocks have many different properties because they come from many other kinds of rocks. They may be squeezed and heated differently and end up with different properties.

Gneiss
• forms from granite (igneous rock)
• has layers (or bands) across the rock
• has minerals that are large enough to be seen
• feels rough

BEFORE
granite
(igneous rock)

AFTER
This piece of gneiss shows bands, or layers, of light and dark minerals.

Quartzite (KWARZ•ight)
• forms from sandstone (sedimentary rock)
• does not have layers (or bands)
• has small minerals inside
• feels smoother than gneiss

BEFORE
sandstone
(sedimentary rock)

AFTER
Quartzite comes in many colors but most often looks glassy.
Marble
• forms from limestone (sedimentary rock)
• does not have layers (or bands)
• can have small minerals and feel smooth
• can have larger minerals and feel rough

BEFORE
limestone
(sedimentary rock)

AFTER
marble
Marble comes in many colors, but is often white.

Slate
• forms from shale (sedimentary rock)
• has layers
• has small minerals and feels smooth

BEFORE
shale
(sedimentary rock)

AFTER
slate
Slate has thin, flat layers.

Quick Check
Circle the letter of the correct answer.

24. Quarzite
   a. feels very rough    b. has layers    c. feels smoother than gneiss

25. Marble
   a. always is green    b. may feel rough    c. has layers

26. Gneiss
   a. has layers    b. feels smooth    c. has small minerals
What are some uses of metamorphic rock?

Metamorphic rocks are useful because of their properties. They are used for buildings, sidewalks, statues, and jewelry. Here are some examples:

- Marble is used for buildings and statues because it does not split when it is carved.
- Slate is used for roofs because it is waterproof. It is used for walkways because it is hard and smooth.
- Quartzite is used for making glass and pottery. It is also used for tile floors and stone walls.

A hard form of coal is a metamorphic rock. It is formed from soft coal, which is a sedimentary rock. Hard coal comes from deeper inside Earth than soft coal. It burns cleaner and longer than soft coal.

Quick Check

Match the rock and its use.

27. _____ slate
   a. burned for energy
28. _____ marble
   b. used to make statues
29. _____ quartzite
   c. used to make glass
30. _____ hard coal
   d. used to make roofs
How can you be a rock detective?

How can you tell if a rock is an igneous rock? How can you tell a sedimentary rock from a metamorphic rock? You can identify each kind of rock by several clues.

**Sedimentary Rocks**
- may contain fossils
- often have layers and can break apart

**Igneous Rocks**
- are usually hard
- do not have layers
- may have minerals that twinkle in the light
- may look glassy (obsidian)

**Metamorphic Rocks**
- may have colored bands

Quick Check
Match the rock and its clue.

31. _____ metamorphic
32. _____ igneous
33. _____ sedimentary

a. may have fossils
b. colored bands
c. is hard and has no layers
The Rock Cycle

Rocks are changing all the time. Any rock is changing into another kind of rock. The continual changing of one kind of rock into another kind is the **rock cycle**. The arrows show some of the ways kinds of rocks are changing into each other all the time.

**The Rock Cycle**

- **Rocks break into bits and get carried away.**
- **squeezing and cementing**
- **heat and squeezing**
- **melting**
- **cools and hardens**

**Reading Diagrams**

Arrows that lead away from any rock show how the rock can change.
How to Read the Rock Cycle

Put your finger on any picture of a rock in the rock cycle. Find the arrows that lead away from the picture. Here is one pathway, following just the outer arrows:

1. Start with “magma or lava” at the bottom of the rock cycle.
2. Follow the blue arrow to the left. Magma or lava cools and hardens and becomes igneous rock.
3. Follow the green arrow leading up from igneous rock to the rock bits. Igneous rocks break into bits and get carried away.
4. Follow the purple arrow leading away from the rock bits. The bits can be pressed and cemented into a sedimentary rock.
5. Follow the gold arrow leading down from sedimentary rock. A sedimentary rock can be heated and squeezed to form a metamorphic rock.

Now follow some of the arrows inside the diagram.

Quick Check

Sandstone (sedimentary rock) has three arrows pointing away from it. Read the arrows to tell three things that can happen to sedimentary rock.

34. ______________________________________________________________
35. ______________________________________________________________
36. ______________________________________________________________
Rocks and Minerals

Complete the sentences below. Fill in each blank with one letter.

1. The ability of a mineral to scratch another mineral is called

   __○__○__ __ __

2. A rock that is formed from another rock that is squeezed and heated is __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

3. Chalk is a __ __ ○○○ __ __ ○ __ __ __ __ __ __ __ __ that is formed from tiny pieces of fossil shells.

4. Some igneous rocks are formed from ○ __ __ __ __ beneath Earth’s crust that has cooled and hardened.

5. Useful minerals can be mined from ○ __ __.

6. A rock is made of one or more __ __ ○ __ __ __ __

Write out all the letters that are in the circles.

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ____

Use the letters from inside the circles above to name two minerals described below. Clue: Look at the table in page 58.

7. If you add the hardness of these two minerals, the sum is 11.

   ______________

   ______________
Use the clues below to fill in the crossword puzzle.

**ACROSS**

2. a rock formed from hot, melted rock that cools and hardens

3. the continual changing of one kind of rock into another kind

5. magma that reaches Earth’s surface

6. the remains of a once living thing from long ago

7. tiny broken bits of rocks, plants, bones, and shells

**DOWN**

1. a part that a rock is made of

4. the way something shines in the light

7. the color of the powder made when a mineral is scratched on white tile
CHAPTER 4

Slow Changes on Earth

Vocabulary

**weathering** breaking down rocks into small pieces

**horizon** a layer of soil

**physical weathering** breaking down rocks into small pieces by hitting them or making them split

**erosion** carrying away broken pieces of rock

**chemical weathering** breaking down rocks by chemicals in the air, water, or ground.

**deposition** dropping off pieces of rock that were carried by wind, water, or ice

**humus** rotted plant and animal remains that becomes part of the soil

**plain** a flat stretch of land without any hills or mountains
What causes Earth’s surface to change slowly?

- **landform** any natural feature on Earth's surface
- **canyon** a deep, narrow landform with steep sides, usually with a river running through it
- **valley** the low land between hills or mountains
- **delta** land built from rock pieces dropped off at the end of a river
- **barrier island** long, narrow land built up from sand dropped off shore
- **sand dune** a hill built from sand that is carried and dropped off by wind
- **glacier** a large moving sheet of ice
What is weathering?

Rocks everywhere are slowly breaking down into small pieces. For example, wind, freezing, and even the growth of plants can cause a rock to break. The breaking down of rocks into small pieces is **weathering** (WETH•uhr•ing).

Weathering can happen in many ways. **Physical weathering** is breaking down rock by hitting them or an any other way making them split apart. Wind and rain are two main causes of physical weathering.

▲ Physical weathering slowly drilled these holes in solid rocks in Arches National Park.
Here are some causes of physical weathering:

- **Freezing and Melting** Water from rain or snow can seep into cracks in rocks. If the water freezes, ice forms. The ice can widen the cracks. Later the ice melts back into liquid water. Freezing and melting over and over break the rock apart.

- **Plants** Plant roots can grow into cracks in rocks and cause them to widen. Eventually the rock splits apart.

- **Peeling Off.** The surface of some huge rocks may peel off into large flakes.

- **Wind** Wind can carry sand and small rocks. Wind-driven sand and rocks act like slow drills. They drill into softer rocks.

---

**Quick Check**

Describe how each of the following causes weathering.

1. Freezing ____________________________

2. Plant roots __________________________

3. Wind driven sand _____________________

---

Roots growing into a crack in a rock can slowly split the rock apart.

The surface of this mountain, Half Dome, peeled away.
What are some other causes of weathering?

You may have seen rust on a bicycle fender. Rust forms slowly and makes the fender crumble. Rust can also form in rocks.

Rust in rocks is a kind of chemical weathering. Chemical weathering happens when chemicals in the air, water, or land break down rocks. Here are some examples.

**Oxygen**

Here's how rusting can happen in rocks:

- Oxygen from the air mixes with water.
- The oxygen and water seep into a rock.
- If a rock has the mineral iron in it, oxygen forms rust in the rock. A rusted rock crumbles.

**Acids**

Acids are chemicals that can gradually eat away rocks. Acids seep into soil from rotting plants. Water seeping through the soil can pick up the acids. When acids come into contact with some kinds of rocks, it can gradually eat away the rocks.
Carbon Dioxide

Carbon dioxide is a gas in the air. It mixes with rainwater and forms an acid. This acid can seep through limestone and eat away a hole in the rock. Over many years, the hole slowly gets bigger and becomes a cave.

Carbon dioxide also comes from rotting remains of animals and plants. Rainwater soaks through the remains, picks up the gas, and forms the acid. The acid then can seep though the soil and eat away holes in rocks.

Quick Check

Fill in the diagram to show how chemical weathering and physical weathering are alike and different.

Physical Weathering
(diff erent)

Alike

Chemical Weathering
(diff erent)

caused by freezing, plants, peeling, and wind

4.

5. caused by

__________

__________

__________

__________

The drip-like formations from the roof of a limestone cave come from water and acid dripping into the cave.
How is soil formed?

What happens to rocks that get broken down into smaller and smaller pieces. In time, the pieces become part of soil.

Soil consists of:

- broken down pieces of rock
- **humus** (HYEW•muhs), which is rotted plants and animals material
- water
- air
- bacteria, some of the tiniest living things (which can be seen only with a microscope)
- plants and animals living in the top layer.

Over time, soil forms layers called **horizons**. Horizons are different from each other.
Here are the three horizons, top to bottom.

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Horizon</td>
<td>The A horizon is topsoil. This layer has plants and animals living in it. Plant roots grow down into it. Animals dig homes in it. It is rich in humus. There are few large rocks.</td>
</tr>
<tr>
<td>B Horizon</td>
<td>B horizon is the subsoil. Some plant roots may grow down into this layer. There is little humus. Broken pieces of rock are scattered through this layer.</td>
</tr>
<tr>
<td>C Horizon</td>
<td>This layer is made up largely of chunks of rock broken by weathering. There is also some rock that has not been broken. There are no plant roots or humus.</td>
</tr>
</tbody>
</table>

Beneath the horizons is bedrock. Bedrock is rock that has not been broken down or has only been partly broken down.

- Bedrock may be the same rock as in the layers above. OR
- The layers above the bedrock may have been carried there from another place and may have different rocks.

Quick Check

Match the layers with the descriptions.

6. _____ A horizon  a. largely rocks broken by weathering
7. _____ B horizon  b. rock that is mostly not broken by weathering
8. _____ C horizon  c. rich in humus
9. _____ bedrock    d. very little humus and some plant roots

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What causes erosion?

Rocks are slowly breaking down into smaller pieces all the time by weathering. The pieces of rock are then carried away by wind or by moving water. Carrying away broken pieces of rock is erosion (i•ROH•zhuhn).

Moving Water

Rivers and waves cause erosion. Small streams and large rivers pick up small pieces of rock as they flow downhill. They can carry the rock pieces for long distances and eventually drop them off.

Waves can break rocks apart in small pieces and sand. The waves can then carry the pieces to new places.
Wind
Wind carries sand, soil, and small pieces of rock. At the same time, wind-driven sand can drill into rocks and wear them away.

Dropping Off Pieces of Rocks
Whenever moving water and wind slow down, they drop off some of pieces of rock they are carrying. Dropping off broken pieces of rock is deposition (dep•uh•ZISH•uhn).

Wind can drop off rocks just about anywhere. Rivers drop them off along the sides, or banks. Just about everything gets dropped off at the mouth, or end, of a river.

Quick Check
Write a sentence about each of these words. Explain how one of these happens first and which happens later.

erosion       deposition

10. ________________________________________________________________

11. ________________________________________________________________

This photo of the Mississippi was taken by a satellite way above the ground. The river is flowing into the Gulf of Mexico and drops off all that it carries.

The Mississippi River
The Gulf of Mexico
dropped off sand and rocks
What affects erosion?

Erosion goes faster when:
- the size of rock pieces and soil is small
- wind or moving water is fast and strong, as in floods or wind storms
- when there are no plants to hold the soil and pieces of rocks down. Plant roots hold soil together and slow up erosion.
- when soil is dry and sandy.

The Dust Bowl

During the 1920s soil was overused by many farmers. In the 1930s, there was almost no rain for almost 10 years. Crops would not grow. The dry, bare soil was carried away by winds causing the Dust Bowl.
The Dust Bowl was the dry, bare area where clouds of sand and dust blew everywhere. Whenever the wind slowed down, sand and dust were dropped off and covered homes and farms. Thousands of farmers had to leave their farms.

**Slowing Up Erosion**

Today farmers can slow up erosion.

- They plant trees between fields to block the wind and hold the soil down.
- They plant crops in strips. One strip is a food crop. The next strip is a plant that holds soil down.
- They plow across a slope, not up and down a slope. This kind of plowing keeps water from rushing downhill and carrying soil away.

**Quick Check**

Fill in the missing “Effects” with slow erosion or fast erosion

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>soil with plant roots</td>
<td>12. _______________</td>
</tr>
<tr>
<td>strong winds</td>
<td>13. ____________________</td>
</tr>
<tr>
<td>plowing across a slope</td>
<td>14. _______________</td>
</tr>
<tr>
<td>dry, sandy soil</td>
<td>15. ____________________</td>
</tr>
</tbody>
</table>

Strips of different crops are planted across a slope rather than up and down a slope.
What is a landform?

If you traveled across North America, you would see many landforms. **Landforms** are the natural features on Earth's surface. They include:

- mountains, the tallest landforms
- hills, land rising above the surface but not as tall as mountains
- **plains**, wide, flat stretches of land without any hills or mountains
- winding rivers
- beaches
- deserts

**Canyon Formation**

The winding river at the bottom of the canyon is still carving out the land, making it deeper and deeper.

**Reading Photos**

The winding river at the bottom of the canyon is still carving out the land, making it deeper and deeper.
Fast Changes, Slow Changes

Some landforms change quickly. For example, a mudslide can flow down a hill in minutes.

Most landforms such as a canyon, change slowly over many years. A canyon is a deep narrow landform with steep sides. Canyons often have rivers at the bottom.

A river drills into the land at the bottom of the canyon and breaks the rocks. The river then carries away the broken rocks. The bottom of the canyon becomes deeper and deeper.

Quick Check

Complete the diagram. With just a few words in each box to sum up how canyons form.

River flows in canyon

16. ___________________
   ___________________

17. ___________________
   ___________________

Summary
   The canyon gets deeper and deeper.
How can running water change land?

When it rains or when snow melts, water can:

- soak into the land
- run over the land.

Water that runs over the land flows downhill. As it flows, the water forms a pathway to the sea. That pathway is a river.

**Down from the Mountains**

High in the mountains water from rain or melted snow forms streams as it flows downhill. The streams come together and form larger rivers.

The rivers break up rocks along their sides. They carry the broken rocks away. As a result, rivers cause valleys to form. A valley is an area of low land between mountains. High in the mountains, valleys are deep with steep sides.

Mountain streams form rivers. The rivers form valleys.
Rivers Curve

As a river flows down mountain, it reaches flatter land. The river slows down. Along one side of the river, moving water drops off some of the rocks it was carrying. The moving water wears away the other side of the river. By dropping off rocks on one side and wearing away the other, a river forms wide curves.

Into the Ocean

A river reaches its end, or mouth, when it flows into an ocean. At the mouth, a river drops off what it is carrying. The dropped off material forms a delta (DEL•tuh), an area of land at the mouth of a river.

Quick Check

Match the part of the river with the landform.

18. _____ curves
19. _____ delta
20. _____ deep valley

a. mouth
b. mountain
c. flat land
As waves pound on a shore, they can cause beaches to change. Waves can pick up sand and move it to another part of a beach. Large waves in a storm can wash away a beach in hours.

**Changing Rocky Cliffs**

Waves can pound into the bottom of a rocky cliff. The bottom of the cliff slowly wears away. The top of the cliff eventually falls because there is little support underneath. The remaining rocks are broken into small pieces and washed away.

Quick Check

21. What do you think will happen to the cliff in the photo as time goes by? ____________________________
Barrier Islands

Barrier islands are long, narrow strips of land built up from sand that was dropped along a shore. Barrier islands run along coasts. They protect coasts from being worn away by waves.

A barrier island changes shape all the time. Waves pick up sand from one part of the island and drop it on another part.

Quick Check

Fill in the boxes with ways waves can change the land.

Waves pick up and drop off sand

22. ___________________

23. ___________________

Summary

Waves change the land.
How can wind change land?

Wind carries sand and bits of rock. These wind-driven particles act like tiny drills. They can drill away softer parts of a large rock or even of a landform, like a hill. Over many years what remains of the landform is a rock with an unusual shape.

Wind can build sand dunes. **Sand dunes** are hills built from sand that is carried and dropped off by wind. When wind is blocked by a rock or a clump of grass, the wind drops off sand. Gradually a small hill builds up around the rock or clump of grass. Sand dunes can change shape as wind blows across them.

Quick Check

Complete the sentence with two answers.

Wind changes the land by making

24. ____________________________________________________________________________.

25. ____________________________________________________________________________.

96
Slow Changes on Earth
How can ice change land?

Many cold parts of Earth have glaciers (GLAY•shuhrz). **Glaciers** are large, thick sheets of ice. They can move slowly across the land by flowing downhill.

Over millions of years, glaciers have moved through valleys and across plains. They have crushed rocks and moved them along. As glaciers melt over time, they leave behind valleys with a wide, deep shape.

Hubbard glacier in Alaska is 122 kilometers (76 miles) long.

Quick Check

Answer the question in complete sentences.

26. Why are glaciers able to change the shape of the land? __________

---

**Quick Check**

Answer the question in complete sentences.

26. Why are glaciers able to change the shape of the land? __________
Slow Changes on Earth

Use a word from the box to name each example described below.

1. Ice forms in a crack in a rock and makes the rock split. _________________
2. Chemicals in the air mix with rocks and eat away holes in them or make them crumble. _________________
3. long, narrow land that forms along a coast or protects the coast _________________
4. sand that is dropped by wind around a rock or clump of grass _________________
5. sand, soil, and pieces of rock carried away by moving water and wind _________________
6. sand, soil, and pieces of rock dropped off by moving water or wind _________________
7. hill, mountain, valley, or canyon _________________
8. a layer of soil, such as topsoil or subsoil _________________

Answer the question. Use at least one word from the box at the top of the page.

9. How can moving water change the land?

___________________________________________________________
___________________________________________________________
Read each clue. Write the answers in the blanks and then fill in the crossword puzzle.

Across
3. a large moving sheet of ice
5. a deep, narrow landform with steep sides, usually with a river running through it
6. breaking down rocks into small pieces

Down
1. the low land between hills or mountains
2. land built from rock pieces dropped off at the end of the river
4. a flat stretch of land without any hills or mountains
7. rotted plant and animal remains that becomes part of the soil
Vocabulary

**landslide** the quick downhill movement of loose rocks and soil

**flood** large amount of water overflowing the sides of a river or a drain

**mudslide** water-soaked land that slides down a hill

**plate** a large, moving piece of the crust

**fault** a crack in the crust

**earthquake** a sudden movement in the crust
What causes Earth’s surface to change quickly?

**volcano** a mountain that builds up around an opening in the crust

**hot spot** a place in the crust where magma rises almost to the surface

**crust** Earth’s outermost layer

**vent** the opening in the center of a volcano

**crater** a cuplike shape that forms around the vent of a volcano

**tsunami** a giant wave caused by an earthquake
How do landslides change the land quickly?

You may have seen skaters or skiers move down a hill. Loose rock and soil can move down a hill as well. They can move slowly, only centimeters a year. However they may also move quickly.

The quick downhill movement of loose rocks and soil is a landslide. In California landslides often occur in the mountains and along the coast.

Landslides happen when loose rocks are shaken, causing them to move downhill, such as by:

- an earthquake or erupting volcano
- storms with heavy rains
- building homes and offices in hilly areas
- the freezing of water in rocks, which can make them split.

This landslide in California was caused by the Loma Prieta earthquake in 1989.
A landslide can move a huge amount of rocks and soil. As it moves it can carry along and bury homes and cars.

**On the Lookout for Landslides**

You can protect yourself from landslides:

- during heavy rains, listen to the TV or radio for landslide warnings
- learn the signs of a possible landslide: tilting of trees and poles, cracking sounds of trees, cracks in bottoms of buildings
- move away from the path of an oncoming landslide. If you can’t, curl up into a tight ball to protect your head.

**Quick Check**

What are two causes of a landslide? What is an effect of landslides? Fill your answers in the diagram.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>landslide</td>
</tr>
<tr>
<td>2.</td>
<td>landslide</td>
</tr>
<tr>
<td>landslide</td>
<td>3.</td>
</tr>
</tbody>
</table>
How do floods change the land quickly?

In any rainfall, some water soaks into the ground and some flows across the land. In a heavy rainfall, water may not soak into the ground fast enough. As a result, a very large amount of water can flow across the land.

The flowing water may spill into a river or drain. A large amount of water overflowing the sides of a river or a drain is a **flood**.

**Effects of Floods**

The large amount of water and its fast speed can cause much damage:

• floods can damage cars and buildings  
• floods can wash away bridges  
• floods can carry away soil from farmland  
• floods can carry soil and mud and drop them onto homes, streets, and cars.

▲ Flooding of the Mississippi River in the early 1990s caused billions of dollars of damage.
Floods and Mudslides

Heavy rain and floods may soak into the land on a hill and cause a mudslide. A **mudslide** is water-soaked land that slides downhill. The flowing mud can bury homes and cars. The mud blocks floodwater from draining away.

**On the Lookout for Floods**

During heavy rains, listen to the local weather reports for *flood watches* and *flood warnings*.

- A flood watch means flooding is possible. Get ready to leave in case you are told to do so.
- A flood warning means that a flood is occurring or will occur soon. You will have to move to higher ground.

---

**Quick Check**

Fill in the missing “Cause” or “Effect” in each row of the diagram.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. ________________________</td>
<td>flood</td>
</tr>
<tr>
<td>5. ________________________</td>
<td></td>
</tr>
<tr>
<td>6. ________________________</td>
<td>mudslide</td>
</tr>
</tbody>
</table>
What are earthquakes?

Earth’s surface is always changing. Most changes are slow, such as weathering. Sometimes changes happen quickly. For example, Earth’s surface can shake or shift suddenly.

Earth’s Moving Crust

Earth’s surface is covered with its crust. The crust is Earth’s outermost layer, much like an apple has an outer layer of skin. The crust is made up of all of Earth’s land, including the ocean bottoms.

The crust is broken into huge pieces, or plates. The plates fit together like puzzle pieces. Unlike puzzle pieces, the plates can move.

Earth’s Plates

The dots and dashes are often found in the same places. This means that earthquakes tend to happen along the edges of plates.
At the edges of the plates, there are cracks in the crust. These cracks are called faults. Along a fault, two plates can move by:

• sliding past each other
• pushing into each other
• pulling apart.

When plates move, earthquakes can happen. An earthquake is a movement in the crust caused by a sudden shift of the plates.

As the red dots in the map show, earthquakes tend to happen at the edges of the plates. Most earthquakes happen around the Pacific Ocean.

Quick Check

Match the description with the word.

7. _____ happens at plate edges  a. crust
8. _____ piece of the crust  b. earthquake
9. _____ crack in the crust  c. plate
10. _____ all of Earth’s land  d. fault
What causes an earthquake?

Earthquakes happen along cracks, or faults, in the crust. Along a fault, parts of the crust on either side may:

- rise up or move down
- slide past each other.

The movement may be very slow, just centimeters a year. In that case, an earthquake does not happen. Instead, when parts of the crust move up or down slowly over many years, mountains may be formed.

When the movement is sudden, an earthquake happens. The ground shakes, or vibrates. The ground may split open. The ground vibrates in all directions from the center of the earthquake. People far from the center of the earthquake may feel a slight shaking.
Earthquake Safety
People who live where earthquakes happen can stay safe. Here are some safety tips:
• Place breakable or heavy objects on lower shelves. Bolt down appliances. These are two ways to keep heavy objects from falling.
• Locate safe spots at home and school—such as under a sturdy table.
• If outside in a quake, move to an open space away from buildings or power lines. This way you can stay safe from things falling on you.
• Have family earthquake drills. Together find a safe spot. Then drop, cover, and hold on. Arrange a meeting place outside the home.
• Drivers should stop during an earthquake. Passengers should stay inside the car.

Quick Check
Fill in the missing “Cause” and “Effects” in the diagram.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>sudden movement along a fault</td>
<td>11. Mountains may form.</td>
</tr>
<tr>
<td>Move away from tall buildings.</td>
<td>14.</td>
</tr>
</tbody>
</table>
What is a tsunami?

Have you ever seen small waves rise and fall as they reach a shore. However, some large ocean waves can be 30 meters (100 feet) tall and travel at a speed of 960 kilometers (600 miles) per hour. That kind of a wave is a tsunami (serve•NAH•mee).

**Tsunami** is a giant ocean wave.

Tsunamis are caused by:

- underwater landslides
- underwater erupting volcanoes
- most often, underwater earthquakes.

An earthquake may be strong enough to set a wave moving. In deep water the wave may pass by unnoticed. Closer to the shore, the wave slows down, but gets taller.

The waves from an underwater earthquake travel outward in all directions. Some of these waves may reach the shore as a tsunami.
A tsunami may reach the shore as one huge wall of water or as several smaller waves. Either way, they are fast and powerful. They wash away beaches, property, and lives.

In December 2004, an earthquake in the Indian Ocean caused a tsunami to hit Sumatra. Then tsunamis reached Sri Lanka in two hours and South Africa in seven hours—800 kilometers (5,000 miles) from the earthquake.

If you are near a coast and learn of an earthquake, listen to news reports for tsunami warnings. If there is a warning, move to higher ground immediately.

Nearly 300,000 people lost their lives in the tsunami of December 2004, mostly in Sumatra.

Quick Check

15. What are some ways a tsunami can form?

16. Why are tsunamis dangerous?
What is a volcano?

Did you ever shake a can of soda and then open it. Shaking releases gas from the soda. The gas explodes in a spray. Something similar can happen to a volcano.

A volcano is a mountain built up around an opening in the crust. The opening may form from a crack. Sometimes magma may melt upward and crack the land. In either case, a volcano may erupt suddenly—forcing out melted rock, gases, and pieces of solid rock.

A volcano erupts when magma (melted rock) below the volcano rises to the surface. Gases escape from the magma as it rises. If the gases escape slowly, a volcano erupts gently. If the gases escape quickly, a volcano explodes.

▲ When Mount St. Helens erupted in 1980, it “blew its top,” leaving a huge cuplike opening at the top. The land around the volcano was buried under ash and soot.
**Rising Magma**

At the center of a volcano is an opening called a **vent**. The vent may form from movement along a fault. Or magma may melt upward and crack through the surface.

As magma rises up through a vent, it reaches the surface. When magma reaches the surface, it becomes **lava**. Lava is melted rock that starts to cool and harden.

Lava can ooze or explode out of a volcano. Either way, it hardens into a layer around the vent. Some volcanoes release ash, which also forms a layer. The volcano gets bigger each time the volcano erupts and lava and ash build up around the vent.

**Quick Check**

Fill in the boxes to explain how a volcano can erupt.

First 17. _____________________________

Next 18. _____________________________

Last The volcano erupts. Lava or ash is released.
What are some kinds of volcanoes?

Volcanoes have different shapes. The shape depends on how a volcano erupts and what it releases when it erupts.

Cinder-Cone Volcano

This kind of volcano:

- is shaped like a cone and has steep sides
- has thick magma inside. This magma has lots of trapped gas.
- forms from explosions.

With each explosion, lava bursts into the air. The lava hardens into rock fragments. The fragments settle into a layer around the vent. A cuplike shape, a crater, forms around the vent.
**Shield Volcano**

This kind of volcano:
- has wide, almost flat sides
- forms from lava flowing from one or more openings.

This kind of volcano forms from layers of lava that build up over years. The Hawaiian Islands are all shield volcanoes.

**Composite Volcano**

This kind of volcano:
- is made up of layers of lava and ash
- has a cone shape with sides that match, one as steep as another.

This kind of volcano forms when it erupts in two ways. It erupts quietly releasing lava. Then it explodes releasing ash. These two ways keep “taking turns.”

**Quick Check**

Match the volcano with the description.

19. _____ cinder-cone
   - a. wide, almost flat sides

20. _____ shield
   - b. forms from lava and ash

21. _____ composite
   - c. forms from rock fragments
**Where do volcanoes form?**

Many volcanoes form at the edges of plates. Remember, plates are pieces of the crust. Volcanoes form where two plates meet.

- **When two plates push together** One plate moves under the other. The plate that moves down under melts and forms magma. The magma rises and forms a volcano.

- **When two plates pull apart** Magma rises up through an opening when plates pull apart. These volcanoes often form along the ocean bottom.

- **Hot spots** Some volcanoes form in the middle of a plate. They form when a plate moves over a hot spot. A **hot spot** is a place where magma has melted part of the way through the crust.
Hawaiian Islands
The Hawaiian Islands are actually volcanoes. They were formed when a plate moved over a hot spot. As the plate moved, magma rose up and broke through the surface. The magma formed one volcano after another in a chain. Hawaii is the youngest island, the only one still erupting.

Volcano Safety
To stay safe where volcanoes may erupt:
• stay away from lava flows
• have breathing masks and goggles ready
• obey your town’s warning system. Leave immediately if told to do so.

Quick Check
How do volcanoes form at each place?

22. where two plates push together ____________________________

23. hot spot _____________________________________________

24. Why are breathing masks important if you live near an active volcano? _________________________________________________
Fast Changes on Earth

Use a word from the box to name each example described below.

1. ____________________________
   the quick downhill movement of loose rocks and soil

2. ____________________________
   water-soaked land that slides down a hill

3. ____________________________
   a sudden movement in the crust

4. ____________________________
   a giant wave caused by an earthquake

5. ____________________________
   a mountain that builds up around an opening in Earth’s crust

6. ____________________________
   a place in the crust where magma rises almost to the surface

Answer the question. Use at least one word from the box at the top of the page.

7. How can moving water change the land? ____________________________

   ____________________________________________________________________
Write the missing words in the blanks. Then find the same words in the puzzle.

1. A cuplike shape that forms around the vent of a volcano ____________________.

2. Earth’s outermost layer ____________________.

3. A crack in Earth’s crust ____________________.

4. Large amount of water overflowing the sides of a river or a drain ____________________.

5. A large, moving piece of Earth’s crust ____________________.

6. the opening in the center of a volcano ____________________.
Electricity

**Vocabulary**

**electric charge**
One of two kinds of particles, positive or negative, that are in objects.

**insulator**
a material that does not let electric charges flow through it easily.

**static electricity**
a build up of electrical charges on an object.

**electric current**
a flow of electrical charges through a material, such as a wire.

**discharge**
a sudden movement of electrical charges from one object to another.

**circuit**
the path of an electric current.

**conductor**
a material that lets electric charges flow through it easily.
How do we use electricity?

**voltage** a measure of how strong a battery or any other power source is

**series circuit** a circuit in which the electrical charges flow through a single path

**parallel circuit** a circuit in which the electrical charges flow through more than one path

**transformer** an electrical tool that increases or decreases the voltage in an electric current

**circuit breaker** an electrical tool that switches off an electric current that gets too high

**fuse** an electrical tool that melts to open a circuit if the electric current gets too high
Lesson 1
Static Electricity

What is electrical charge?

What is electricity? To answer the question, you need to think that everything is made up of tiny particles, too small to be seen.

Each of these tiny particles can have an electrical charge. There are two kinds of electrical charge, positive or negative, that can:

- repel (push away) each other—if they are the same kind of charge
- attract (pull toward) each other, if they are opposite charges.

**Diagram:**

- Two positive charges repel each other
- Two negative charges repel each other
- Opposite charges attract each other
Charges Add Up

Most objects are made up of the same number of positive and negative charges. Objects with the same number of both charges are neutral (NEW•truhl).

When two objects touch or nearly touch, charged particles can move from one object to the other. Negative charges move from object to object more easily than positive charges.

For example, rub a balloon with a wool cloth:
• negative charges move from the wool to the balloon
• the balloon now has more negative charges than positive charges. The balloon is negatively charged.

Quick Check

Fill in each empty particle with a “+” or “-” to show if the two particles attract or repel.

1.  

2.  

Draw arrows in between these particles to show if these two are attracting or repelling.

3.  

Charged particles in the girl's hair are attracted to the charged balloon.
What is static electricity?

A balloon starts out with the same number of positive charges and negative charges. Remember what happens if you rub the balloon with a wool cloth? Negative charges move from the wool to the balloon.

Rubbing causes a **buildup** of negative charges on the balloon. A buildup means that there are now more negative charges on the balloon than positive charges. The balloon is negatively charged. A buildup of electrical charges on an object is called **static electricity**.

![Overall Charge](image)

A neutral balloon has 5+ and 5–. The positively charged balloon has 5+ and 2–. The negatively charged balloon has 5+ and 7–.

**Quick Check**

4. Why are the two balloons in the diagram attracting?

---

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Electricity
As you saw, rubbing can cause negative charges to move from one object (such as wool) to another (a balloon). Charged particles can also move inside an object.

Think of what happens when you try this:
• Rub a balloon with wool. Rubbing causes a buildup of negative charges on the balloon.
• Hold the negatively charged balloon near a wall. Positive charges in the wall are attracted to the balloon and move toward it. Negative charges in the wall are repelled from the balloon and move away.
• The wall and the balloon attract each other. The balloon sticks to the wall.

Quick Check
Complete the Main Idea diagram. List two details that help explain the main idea.

<table>
<thead>
<tr>
<th>Main Idea</th>
<th>Details</th>
</tr>
</thead>
</table>
| The balloon sticks to the wall. | 5. 
6. |
What is an electrical discharge?

Follow this sequence of events:

1. You walk across a carpet, dragging your feet.

2. Negative charges move from the carpet and build up on your body. You become negatively charged.

3. You reach out to touch a metal doorknob to open a door. OUCH!

When your finger gets close to the doorknob, negative charges move from your finger to the doorknob. The sudden movement of electrical charges from an object where they are built up to another object is a discharge. You feel the discharge as a small shock.

Quick Check

Correct each of these false sentences.

7. You become positively charged when you walk across a rug. ________________________________
   ________________________________

8. You feel a shock when negative particles move from the doorknob to your hand. ________________________________
   ________________________________
What conductors and insulators?

How can you avoid getting a shock from touching a metal doorknob? Touch the wooden door first. Why?

The metal is a conductor. A conductor is a material that lets charges flow through it easily. Charges race to the metal doorknob and flow into it. You feel a shock.

Metals such as copper and silver are good conductors. Even a person can be a conductor. That’s why you can get a shock when another person touches you.

Wood is an insulator. An insulator is a material that does not let charges flow through it easily. When you touch a wooden door, charges move slowly onto the door. You don’t feel a shock. Other insulators are:

• glass
• rubber
• plastic

Quick Check

In each row cross out the word or words that do not belong.

9. conductor glass copper silver lets charges flow
10. insulator copper rubber does not let charges flow
What is lightning?

Lightning is a discharge of static electricity between:
- a cloud and the ground
- two clouds
- two oppositely charged parts of a cloud.

To help you understand how lightning forms, remember that charges can move inside something. Charges can move to different parts of a cloud and the ground. Now follow the numbers in the diagram to see how lightning occurs between a cloud and the ground.
**Lightning Safety**

Lightning takes the shortest path to the ground. It hits the tallest object or best conductor.

If you hear thunder or see lightning, follow these rules to stay safe:

1. Find shelter inside a building, a car, or truck. Do not seek shelter under a tree.
2. If you are far from any shelter, then go to the lowest point and squat or lay down. You do not want to be the tallest object in the area.
3. If you are in the water (such as a pool, the ocean, or a lake), get out of the water immediately. Lightning often strikes bodies of water.

**Quick Check**

11. What causes lightning to form between the cloud and the ground?

Fill in the Main Idea diagram. List two details that support the main idea.

<table>
<thead>
<tr>
<th>Main Idea</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>You can be safe when there is lightning.</td>
<td>12. ____________________________</td>
</tr>
<tr>
<td></td>
<td>13. ____________________________</td>
</tr>
</tbody>
</table>
Lesson 2
Electric Circuits

What is electric current?

When you plug in a TV set and turn it on, electric charges are flowing through wires. A flow of electric charges is an **electric current**. In an electric current, electric charges keep moving until you turn the current off.

**Circuits**

An electric current needs a path to carry the charges. The path an electric current follows is a **circuit**. A circuit has several parts:

- a power source—such as a battery
- a load—something that uses electricity to work such as a lamp, a TV, or a computer
- wires and other things that connect the parts

Many circuits also have a switch. A switch is used to turn the electric current on or off. The circuit shown here has all the parts, So why do you think the bulb is not lit up? The switch is up.

![Diagram of an electric circuit with a battery, switch, and light bulb. The switch is in the up position, indicating that the circuit is broken and electric current cannot flow.](image-url)
Open and Closed Circuit

When the switch is up, the circuit is open. An open circuit has a break or opening. Electric current cannot flow in an open circuit. Circuits are open if a bulb burns out or if wires are loose.

The switch is closed in the circuit below. Current flows because there are no breaks in the circuit. A complete, unbroken circuit is a closed circuit.

Every circuit needs a power source, something that moves the electrical current. The power source shown here is a battery. Any power source has a certain amount of voltage (VOHL•tij). Voltage is the strength of a power source with greater voltage, more electric current can flow.

Quick Check

Match the description with the word.

14. _____ something that uses electricity  
   a. circuit

15. _____ a flow of electric charges  
   b. voltage

16. _____ a path for the electric charges  
   c. load

17. _____ the strength of a battery  
   d. electric current
What is a series circuit?

What are the parts of the circuit shown in the diagram and the photograph? Start with a battery. There are two bulbs. A wire is used to connect the battery and the bulbs.

This simple circuit does not need a switch. As soon as all the parts are connected, the circuit is closed. Electric current flows and both bulbs light up.

This is a series (SEER•eez) circuit. In a series circuit, all the electrical charges flow in one direction along a single path. There is only one way for the electric current to go.

Series Circuit

In a series circuit, the parts are connected all in one path. All the electric current passes through each part.

Reading Diagrams

Starting with the battery, follow the arrows in the diagram. They show how the electric current is flowing.
If any part of a series circuit is removed, the circuit is open. None of the parts will work because the electric current stops flowing.

For example, the electric current stops if one bulb burns out or is removed from the circuit. Because the electric current stops, the other bulb no longer lights up.

Quick Check

Complete the diagram below.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect all the parts of this series circuit.</td>
<td>18. _________________</td>
</tr>
<tr>
<td>Remove one bulb from the circuit.</td>
<td>19. _________________</td>
</tr>
</tbody>
</table>
What is a parallel circuit?

If one light goes out at home, the rest of the lights stay on. They stay on because parallel (PA•ruh•lel) circuits are used. In a parallel circuit, electric current flows through more than one path.

The pictures here show how a parallel circuit works. The parts are the same as the parts in a series circuit. However, the parts are connected so that there are two paths for the electric current.

In a parallel circuit, some of the electric current flows through one path. Some flows through another path. In bigger circuits, there may be many more than just two paths.
If any path of a parallel circuit is opened, the current still flows through the other paths. So if a light bulb in one path is removed or burns out, other bulbs in other paths can still stay lit.

One danger is that all the electric current may flow through one very short path, a short circuit. The result can be overheated wires and a fire.

Quick Check

20. How can you tell a parallel circuit from a series circuit? _______________

21. Why is a parallel circuit helpful at home? ________________
How is electrical energy used?

Energy comes in many forms. Electrical energy is one form. Other forms are heat, light, and motion.

Electrical energy can be changed into other forms all the time in useful ways.

- **heat** When electric current passes through very thin wires, it slows down—much like cars slowing down when a road gets narrow. When electric current slows down, the wires get hot. Burners, heaters, hair dryers, and toasters produce heat by using certain wires that cause electric current to slow down.
- **light** When electric current flows through thin wires, the wires can get hot enough to glow. That is how some light bulbs work.
- **motion** Electric motors change electric current to motion. Motors run trains, washing machines, and cars.

Quick Check

For each device, tell what change of energy takes place.

22. car ____________________________________________

23. hair dryer ______________________________________

23. bulb __________________________________________
How can we use electricity safely?

Here are two tips for using electricity safely:

• **bared wires** Be sure the coating around a wire is unbroken. The coating is an insulator. If the coating tears and the wire is bared, the wire can touch another wire. A short circuit can heat the wire and start a fire.

• **overloaded outlets** Never plug too many devices into one outlet. They can overheat circuits in the wall and start a fire.

Homes and buildings are protected against overheating wires. Circuits are protected by:

• **circuit breakers**, which switch open a circuit if the current gets too high.

• **fuses**, which melt, causing a circuit to open if the current gets too high.

Quick Check

25. To use electricity safely at home, look out for ____________________
Before reaching your home, electric current goes through a transformer like this one. This transformer decreases voltage.

How does electrical energy get to your home?

Power plants produce electricity. From the power plant electric current travels along long power lines to homes and businesses.

Electric current leaves a power plant with a voltage of about 25,000 volts. That is high voltage, very dangerous to be near. However, it is not enough voltage for power lines to carry the electric current to towns and cities.

An electric tool called a \textbf{transformer} can change the voltage. Electric current from the power plant enters a transformer. The transformer increases the voltage to about 400,000 volts!
Before electric current reaches your home, it goes through other transformers. These transformers lower the voltage to safe levels. Most homes run on 120 volts or 240 volts.

Then current travels through different power lines back to the power plant. Transformers increase the voltage for the “trip.”

**Quick Check**

Tell how electric current gets to your home.

**First**  Electricity is produced by a power plant.

**Next 26.** Transformers ____________________________

**Last 27.** Transformers ____________________________

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Electricity

Match the words in the first column to the best answer in the second column.

1. electrical charge  ____  a. an electrical tool that switches off an electrical current that gets too high
2. static electricity  ____  b. a circuit in which the electrical charges flow through more than one path
3. electric current  ____  c. one of two kinds of particles in objects, positive or negative, that can cause objects to pull toward each other or push away from each other
4. series  ____  d. a flow of electrical charges through a material, such as a wire
5. parallel  ____  e. a buildup of electrical charges on an object
6. circuit breaker  ____  f. a circuit in which the electrical charges flow through a single path

Answer the following questions. Use one or more words from the first column above in each answer.

7. What happens when you rub a balloon with a wool cloth? ____________________________________________

8. Each of two circuits has two bulbs. You remove a bulb from each circuit. In one circuit the remaining bulb goes out, but in the other circuit it stays lit. What’s the difference? ____________________________________________
Use the clues to fill in the crossword puzzle below.

**ACROSS**

6. An electrical tool that increases or decreases the voltage in an electrical current

7. An electrical tool that melts to open a circuit if the electrical current gets too high

**DOWN**

1. A material that lets electric charges flow through it easily

2. A measure of how strong a battery or any other power source is

3. A material that does not let electric charges flow through it easily

4. A sudden movement of electrical charges from one object to another

5. The path of an electric current
CHAPTER 7

Magnetism

Vocabulary

**magnet** any object that attracts certain metal objects

**pole** the part of a magnet where the ability to push or pull is the strongest

**magnetic field** the area around a magnet where it can push or pull another magnet

**compass** a tool that shows directions by letting a needle line up with Earth's magnetic field

**electromagnet** a magnet that is made when an electric current flows through a coiled wire around an iron rod

**loudspeaker** a tool that changes electrical energy into sound
How do we use magnets?

**microphone** a tool that changes sound into electric signals

**motor** a tool that changes electrical energy into energy of motion

**generator** a tool that changes energy of motion into electrical energy

**alternating current** electrical current that flows in one direction and then in the opposite direction, back and forth

**direct current** electrical current that flows in just one direction
What is a magnet?

You may have used magnets to pull (or attract) things made of metal, like steel paper clips. A magnet is any object that attracts certain metal objects. A magnet also can attract or can push away (repel) another magnet.

Refrigerator Magnets

Refrigerator magnets are made up of very tiny strips of magnets placed next to each other. The way they are arranged causes the ability to attract to be very strong on one side of the magnet. That is why one side of the magnet attracts (or sticks to) the metal in a refrigerator.

Magnets come in many shapes—bars, circles, and this horseshoe shape. They attract metallic paper clips, but not plastic paper clips.
**Magnetic Poles**

Hold two bar magnets by strings. Point the ends toward each other. The ends will push or pull each other. The ends of a bar magnet are its poles. A **pole** is the part of a magnet where the ability to push or pull is the strongest.

Magnets have two poles—north (N) and south (S). When the poles are brought together:

1. Opposite poles (north and south) attract each other.
2. Like poles (south-south or north-north) repel each other—that is, they push away from each other.

The ability to attract or repel depends on how far apart two magnets are. The farther apart two magnets are, the weaker their ability to attract or repel each other becomes. Far enough apart, the magnets do not attract or repel at all.

**Quick Check**

Fill in each space with an N or S to show that the two bar magnets attract or repel.

1. repel

   \[ S \quad \_\_\_\_\_ \quad \_\_\_\_\_\_ \]

2. attract

   \[ S \quad \_\_\_\_\_ \quad \_\_\_\_\_\_ \]
How do magnets attract?

Magnets attract some metal objects, like metal paper clips. How do magnets attract metals? When you bring a magnet near some metal objects, the metal objects actually become magnets. Here’s how:

1. Magnets are made of metals. Metals are made of tiny particles. These particles are like tiny magnets. Inside a magnet, these tiny magnetic particles are all lined up. All the north poles face one direction. All the south poles face the other.

2. Magnets attract certain metals, such as iron, nickel, and cobalt. If a metal is not a magnet, the metal still has tiny magnetic particles inside. However, they are not lined up. North poles and south poles are facing many different directions.

Inside this magnet, all north poles are facing left. All south poles are facing right.

This piece of metal is NOT a magnet. The tiny particles inside are facing many directions.
3. Bring a bar magnet or any other permanent magnet near a piece of iron, nickel, or cobalt. The tiny magnetic particles turn around and line up. The metal becomes a temporary magnet. This temporary magnet attracts the bar magnet.

4. Take the permanent magnet away from the piece of metal. Usually, the tiny particles move around and face many directions again.

Quick Check

Fill in this diagram to show what happens when you bring a bar magnet next to a piece of iron.

3. First In a piece of iron, the tiny particles are

4. Last Now the tiny particles inside the piece of iron are
What is a magnetic field?

When you pull or push something, you have to touch it. A magnet can pull or push without touching. How?

Every magnet has a magnetic field around it. A magnetic field is the area around a magnet where it can push or pull another magnet.

Look at the magnetic field traced by iron filings. If you move another magnet into this magnetic field, the two magnets will:
- attract if opposite poles are facing each other
- repel if like poles are facing each other.

The magnetic field is strongest at the poles. Farther away from the poles, the ability to attract or repel becomes weaker and weaker.

Quick Check

Correct each of these false sentences.

5. Two magnets will repel if opposite poles are facing each other. _____

6. A magnetic field is weakest at the poles. _________________

These tiny pieces of iron are on a glass plate held over a magnet. When the plate is shaken, the iron pieces trace the magnetic field around the magnet.
What is a compass?

Earth is a giant magnet. Part of the inside of Earth is made up of melted iron. This iron sets up a magnetic field around Earth.

The north pole of Earth’s magnetic field is located near the geographic North Pole. Earth’s magnetic south pole is located near the geographic South Pole.

A **compass** is a tool that gives directions. It is made up of a free-spinning magnetic needle that lines up with Earth’s magnetic field. It points to the magnetic north pole.

**Quick Check**

In each row cross out the word (or words) that does (do) not belong.

7. magnetic field  Earth  poles  land

8. north  equator  compass  south
What is an electromagnet?

When an electric current flows through a wire, it sets up a magnetic field around the wire. The field is stronger if you wind the wire into a coil.

Just add one more item, an iron rod (or nail), and you can make an electromagnet. An electromagnet is a magnet made when an electric current flows through a coil of wire wrapped around an iron rod. When current flows, the iron rod acts like a magnet. Its two ends become north and south poles.

Quick Check

Complete the diagram to tell how to make an electromagnet.

9. **First** Wind a wire into a ________________________.

10. **Next** Wrap the ________________________.

11. **Last** Attach the ends of ________________________.
How are electromagnets used?

Electromagnets are often more useful than permanent magnets because:

• you can turn them on and off by switching the current on and off
• you can make them stronger by increasing the current and/or the coils of wire.

Electromagnets are used in many things people use everyday, including:

• doorbells
• motors that run hobby trains and cars
• electric guitars.

Quick Check

12. To turn on an electromagnet, all you have to do is ____________

13. One way to make an electromagnet stronger is to ____________
How does a loudspeaker work?

Electromagnets are used in loudspeakers. A loudspeaker is a device that changes electrical energy into sound. Loudspeakers produce sound in radios, stereos, televisions, and headphones.

Inside the loudspeaker, an electromagnet is attached to a diaphragm (DIGH•uh•fram). The diaphragm is a cup-like surface that can make sound when:

- a current flows through an electromagnet inside the loudspeaker
- the electromagnet is pushed and pulled by a permanent magnet
- at the same time, the diaphragm also moves back and forth (vibrates) and makes sound.

**How a Loudspeaker Works**

[Diagram showing a loudspeaker with a diaphragm, electromagnet, and permanent magnet.]

**Reading Diagrams**

When current flows, an electromagnet is attracted and repelled by a permanent magnet over and over again.

Magnetism
Telephones

Telephones use electromagnets. A telephone receiver is a tiny loudspeaker. When someone calls you:

• the person speaks into a mouthpiece. The mouthpiece is often a microphone (MIGH•kruh•fohn). A **microphone** uses a magnet to change sound into electric signals
• the signals travel to your receiver
• your receiver uses an electromagnet just as any loudspeaker does—to change the signals into sound.

Quick Check

Match the object with its description.

14. ____ loudspeaker  
15. ____ microphone  
16. ____ diaphragm

- a. changes sound into electric signals  
- b. vibrating part of microphones and loudspeakers  
- c. changes electric signals into sound

The Parts of a Receiver

Reading Diagrams

The labels identify the two parts of a telephone used for peaking and listening.

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What is an electric motor?

Just about any electrical device that has moving parts inside uses an electric motor. An electric motor changes electrical energy into motion.

Electric motors operate:
• air conditioners
• refrigerators
• electric toys, such as trains and cars
• power tools.

A simple electric motor has several parts:
• a source of power—such as a battery or a plug
• a permanent magnet
• a loop of wire that can spin
• a motor shaft—a rod that can spin and move

An electric motor in this toy car changes electric energy into the spinning motion of the wheels.
Here is how a motor works:

1. An electric current runs through the wire loop, making a magnetic field around the coil.

2. The permanent magnet then pushes and pulls on the wire loop, making the loop spin.

3. The spinning wire loop spins the shaft.

4. The shaft, in turn, spins a wheel or gear.

In larger motors, the loop of wire is a coil of wire. The coil is wound hundreds of times around an iron tube. This makes a very strong electromagnet for moving heavy objects or making things move very fast.

Quick Check

Tell if each sentence is true or false. If false, correct the sentence.

17. Electric motors use motion to produce electrical energy.

18. In a motor, a magnetic field is made around the wire coil.

19. In a motor, the spinning wire loop spins the permanent magnet.
What is a generator?

Almost all of our electrical energy is produced by generators (JEH•nuh•ray•turz). A generator changes motion into electrical energy. That is exactly the opposite of what a motor does.

Here’s how a generator works:

1. Wind, flowing water, or steam is used to spin a turbine (TER•bin). A turbine is a part that looks like a pinwheel or an electric fan.
2. The turbine is connected to a wire loop. The spinning turbine turns the wire loop between the poles of a permanent magnet.
3. The magnet is surrounded by a magnetic field. Current flows through the wire loop as the loop moves through the magnetic field.

Reading Diagrams

What causes the wire loop to spin?

LOG ON Science in Motion Watch how a generator works @ www.macmillanmh.com
One way generators can work is by making a coil of wire spin inside a magnetic field. Another way generators can work is just the opposite. Make a magnetic spin inside of a coil of wire.

For example, to make this hand-made model work:

1. Spin the nail. The magnets stuck to the clay spin inside the coil of wire.
2. Current will flow through the coil of wire.
3. The current sets up a magnetic field around the compass. The magnetic field causes the compass needle to move. When you see the needle move, you know current is flowing.

Quick Check

Tell which of these steps happens first, second, and third. Label them 1, 2, and 3.

20. _____ As the wire loop spins inside a magnetic field, current flows through the wire.

21. _____ The spinning turbine, in turn, causes a wire loop to spin.

22. _____ Wind or flowing water make a turbine spin.
What are sources of electrical energy?

A generator works because energy of motion is needed to make the turbine spin. Where does that energy of motion come from?

The word source (SAWRS) is used to describe where something comes from. Generators have several sources of energy.

<table>
<thead>
<tr>
<th>Source of Energy</th>
<th>How It Is Used in a Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>fossil fuels</td>
<td>Oil, coal, and natural gas are burned to heat water. Steam from hot water turns turbines.</td>
</tr>
<tr>
<td>nuclear energy</td>
<td>Energy is released from inside atoms. This energy heats water and produces steam.</td>
</tr>
<tr>
<td>geothermal energy</td>
<td>Heat from under the ground is used to produce steam.</td>
</tr>
<tr>
<td>hydropower</td>
<td>Flowing water (a river or waterfall) can spin turbines.</td>
</tr>
<tr>
<td>wind</td>
<td>Wind can spin turbines.</td>
</tr>
</tbody>
</table>

Many generators use heat to produce steam. The steam spins the turbines.

Quick Check

23. Which sources of energy can spin a turbine without making steam? 

________________________________________
What kinds of electric current are there?

The electric current that most generators make is an alternating current (AC). An alternating current flows in one direction and then in the opposite direction. Electrical charges flow back and forth, over and over again.

Alternating current is available in electrical wall outlets. You use alternating current when you plug in an electric device and turn it on.

When you use a battery, you are using direct current (DC). A direct current is an electric current that flows in just one direction.

Many computers need direct current. Yet you plug them into an outlet. These computers have a part inside that changes alternating current from the outlet into direct current.

Quick Check
Summarize what you learned on this page by filling the diagram.

24. ______________________________________ 25. ______________________________________

Summary
There are two kinds of electric current
Magnetism

Choose the letter of the best answer.

1. The area around a magnet where it can push or pull another magnet is a(n)
   a. magnetic field
   b. compass
   c. pole
   d. electric current

2. A magnet that is made when an electric current flows through a coiled wire around an iron rod is a(n)
   a. permanent magnet
   b. alternating magnet
   c. pole
   d. electromagnet

3. Electrical energy is changed into sound by a(n)
   a. generator
   b. microphone
   c. loudspeaker
   d. motor

4. Electrical current that flows in one direction and then in the opposite direction, back and forth, is a(n)
   a. direct current
   b. alternating current
   c. parallel
   d. closed

5. Electrical current that flows in just one direction is a(n)
   a. direct current
   b. alternating current
   c. parallel
   d. closed

6. Loudspeakers, microphones, and doorbells all work by using a(n)
   a. motor
   b. generator
   c. electromagnet
   d. turbine
1. Any object that pulls (or attracts) certain metal objects is a(n) __ __ __ __ __ __.
2. The part of a magnet where the ability to push or pull is the strongest is a(n) __ __ __ __ __.
3. A tool that shows directions by letting a needle line up with Earth’s magnetic field is a(n) __ __ __ __ __ __ __ __ __ __.
4. Electrical energy is changed into energy of motion by a(n) __ __ __ __ __ __.
5. Sound is changed into electric signals by a(n) __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ 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