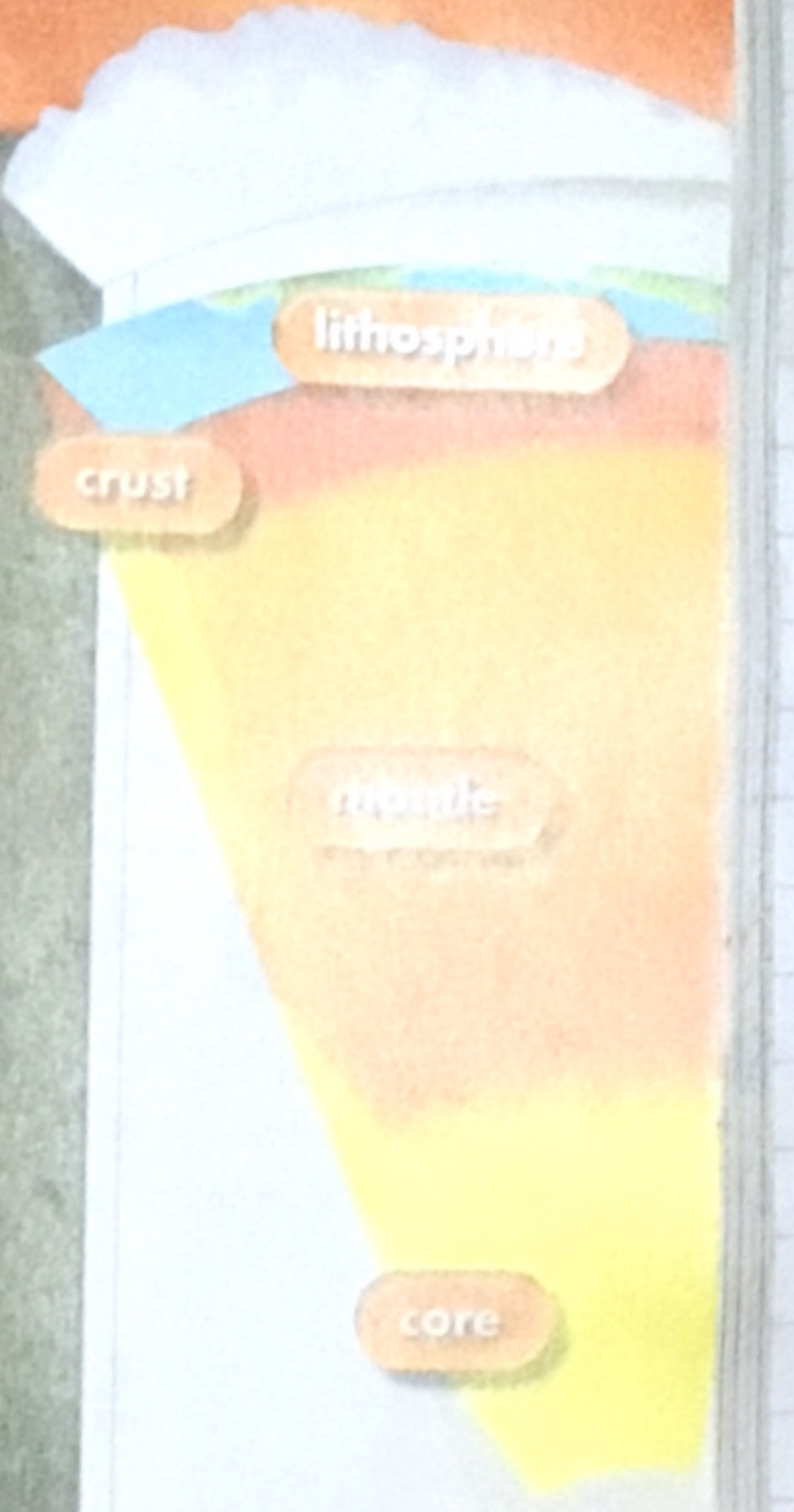
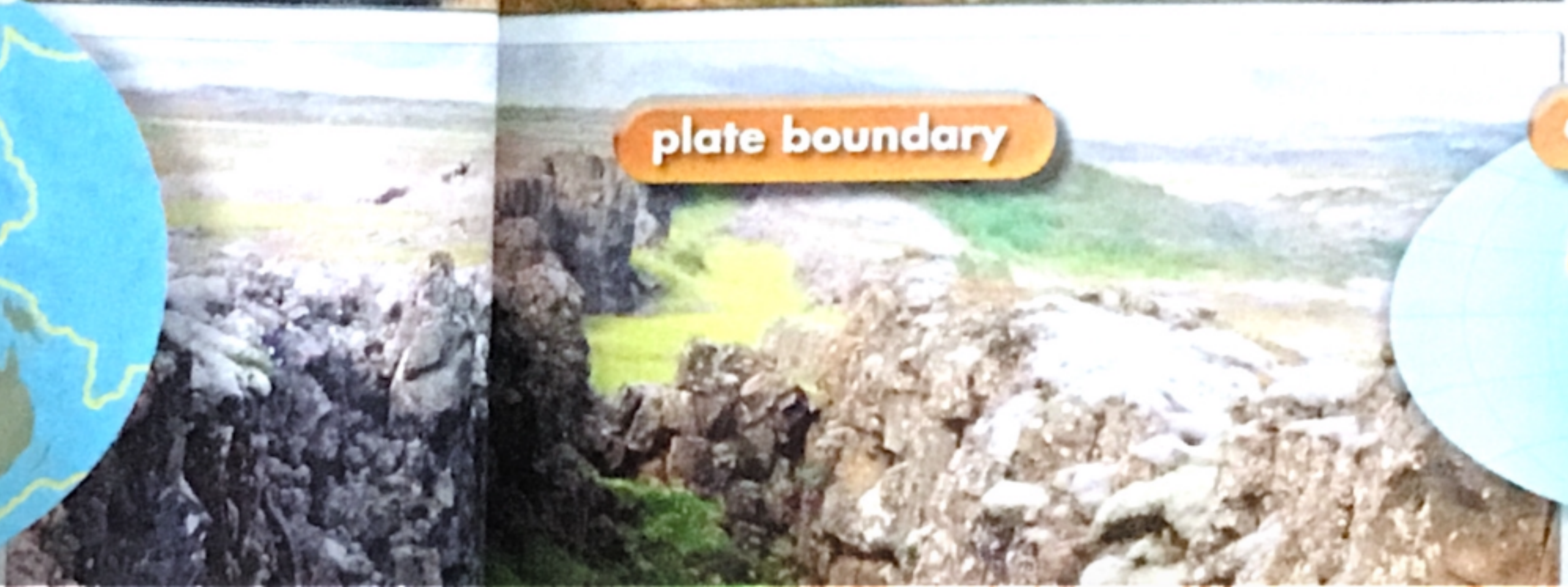
Science ch. 8

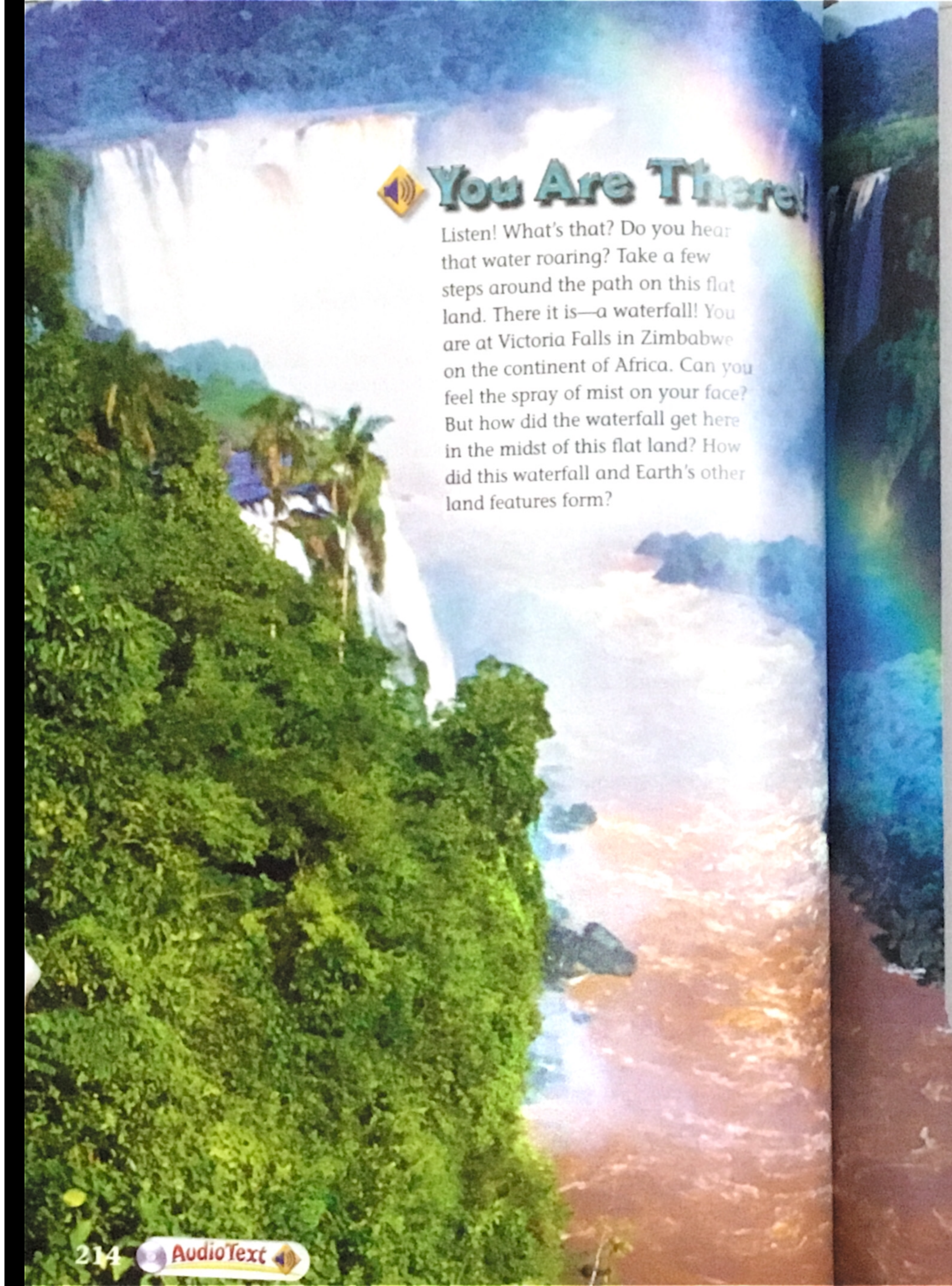
Plate Tectonics

How does the theory of plate tectonics explain Earth's landforms?

Chapter 8 Vocabulary







You Are There!

Listen! What's that? Do you hear that water roaring? Take a few steps around the path on this flat land. There it is—a waterfall! You are at Victoria Falls in Zimbabwe on the continent of Africa. Can you feel the spray of mist on your face? But how did the waterfall get here in the midst of this flat land? How did this waterfall and Earth's other land features form?

Lesson 1

What are Earth's layers made of?

Earth has a variety of surface features. Beneath Earth's crust are the mantle and core.

The Naukluft Mountains in Namib Desert, Africa

Earth's Variety

Victoria Falls is just one of Earth's many land features. The area around Victoria Falls is raised, flat land called a plateau. Water from the falls plunges into a gorge, or deep crack, in the plateau. In the United States, a very large plateau, the Colorado Plateau, covers areas of Utah, New Mexico, Arizona, and Colorado. At one time, this plateau was flat, but over thousands of years water has washed away some of the rock. Landforms such as the Grand Canyon are the result.

Depending on where you live, you might find other landforms, such as mountains, plains, and valleys. In the southern African desert of Namib, mountains rise high above the surrounding plains. Plains are flatlands with few trees. Valleys, such as the Napa Valley region in southern California, are found where mountains are close together.

Napa Valley, California

Some of Earth's features are hidden by water. For example, beneath the Atlantic Ocean is a ridge, or long row, of towering mountains. Some of those mountains are volcanoes. Also below the ocean are trenches—long, narrow canyons in the ocean floor.

Although these features differ in many ways, they all formed from processes that began deep inside Earth. To understand the process, you need to understand what Earth is like inside.

1. ✓ **Checkpoint** What are trenches and ridges?
2. **Social Studies in Science** Choose a continent and research its most important land features. Draw a map that shows where the land features are located. Include brief descriptions of each feature on your map.

Earth's Layers

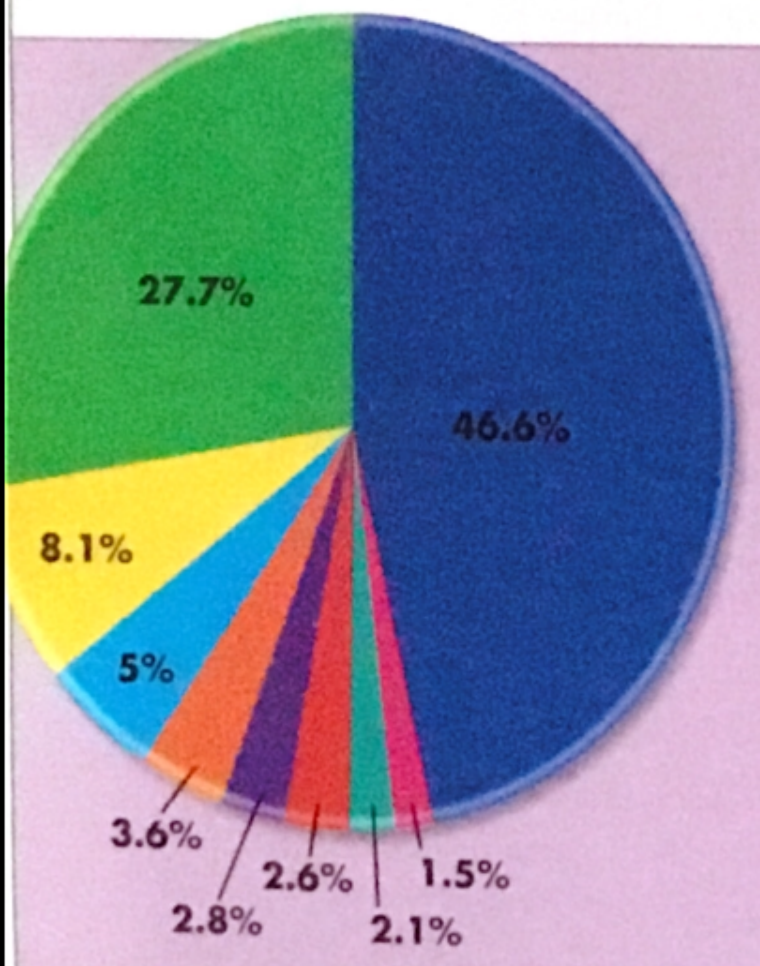
Sometimes Earth is described as a giant rock in space. In one way, that's true. Earth's surface is solid and is made of rock and soil. But Earth has different layers, and not all of them are solid.

Above Earth's surface is the atmosphere. Parts of the atmosphere constantly interact with Earth's land. This thin layer of gases is the air we breathe. Humans could not live on Earth without the atmosphere. In fact, Earth's atmosphere makes it the only planet we know of that can support life.

The outermost solid layer of Earth is the **crust,** the part of Earth we live on. It includes the soil and rock that covers Earth's surface. The thickness of the crust varies. The part of the crust covered by ocean water is about 6–11 kilometers thick. The part that is dry land is about 35–40 kilometers thick. When you think about high mountains, which are part of Earth's crust, you may think the crust is thick. Compared to the size of the Earth, the crust is just a thin shell.

The layer of Earth just below the crust is the **mantle.** This thick layer contains most of Earth's mass. The outer part of the mantle is solid, like the crust. The inner part is so hot that the rock can flow very slowly over time.

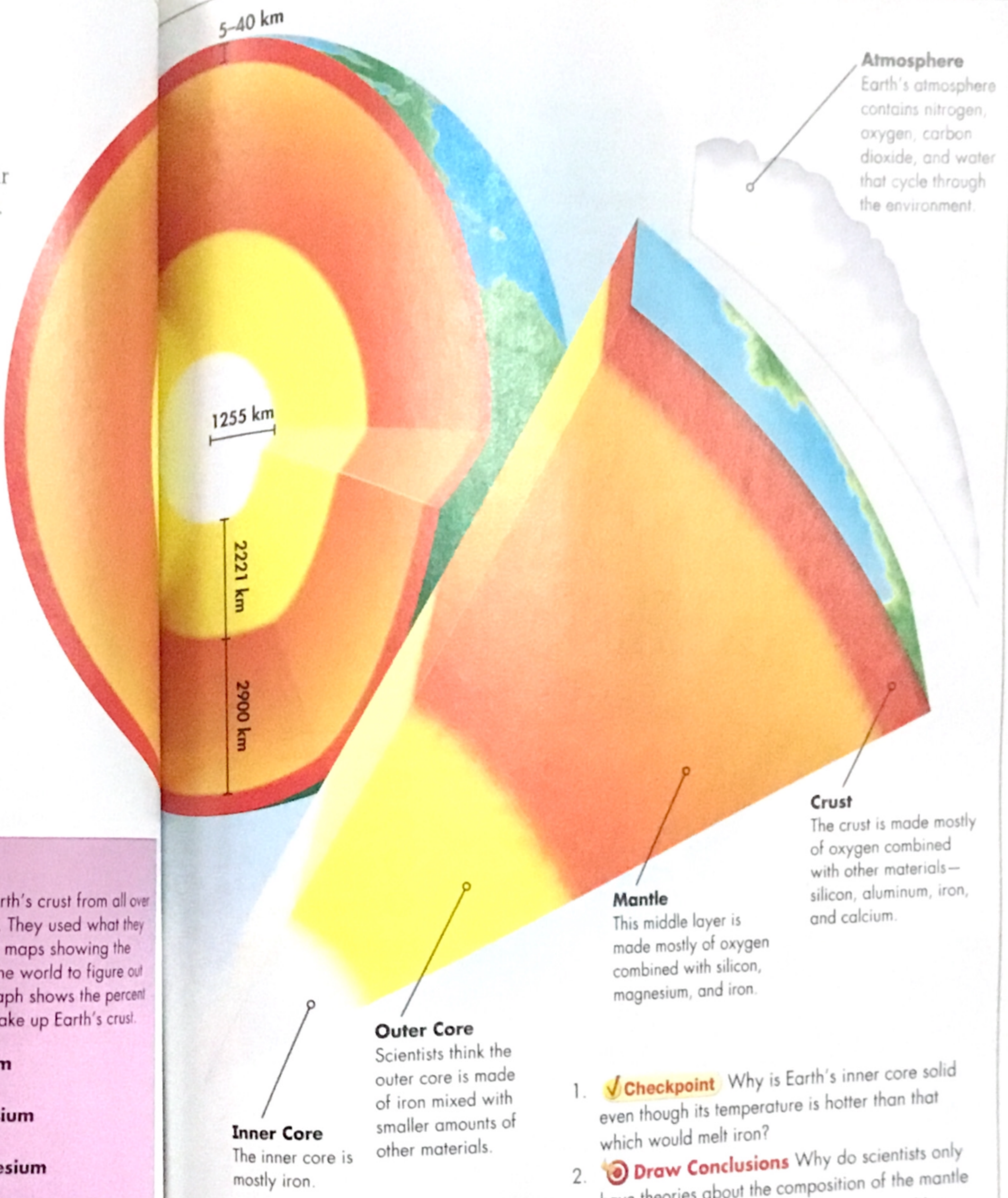
The **core** is the innermost layer of Earth. It is much denser, or compacted, than the mantle because of the weight of all the rock above it. The temperature of the core is thought to be about 7,000°C. That's as hot as the surface of the Sun. The outer core is so hot that it is a liquid. The inner core is solid.



Earth's Crust

Scientists have studied samples of Earth's crust from all over the world, including the ocean floors. They used what they learned from these samples and from maps showing the kinds of rock that are found around the world to figure out what Earth's crust is made of. The graph shows the percent by weight of several materials that make up Earth's crust.

- Oxygen
- Silicon
- Aluminum
- Iron
- Calcium
- Sodium
- Potassium
- Magnesium
- All others



1. **Checkpoint** Why is Earth's inner core solid even though its temperature is hotter than that which would melt iron?
2. **Draw Conclusions** Why do scientists only have theories about the composition of the mantle and core, but they know the exact composition of the crust?

Earth's Plates

In some ways, the outer part of Earth is like an eggshell. If you boil an egg too long, the inner part becomes a soft solid, but the shell breaks into pieces. Earth's crust and the upper part of the mantle are called the **lithosphere.** Like a cracked eggshell, the lithosphere is not a continuous layer. It is broken into pieces called tectonic plates. The plates all have different shapes and sizes. Some, like the South American Plate, are the size of continents. Others, such as the Caribbean Plate, are much smaller. All the plates fit together like the pieces of a jigsaw puzzle.

You can see on the map that the plates don't follow the edges of the continents. Many of the plates are made of both continental crust—the crust that makes up continents—and oceanic crust—the crust that makes up the floor of the ocean. Most of the United States is on the North American Plate. Much of the Atlantic Ocean is also on this plate.

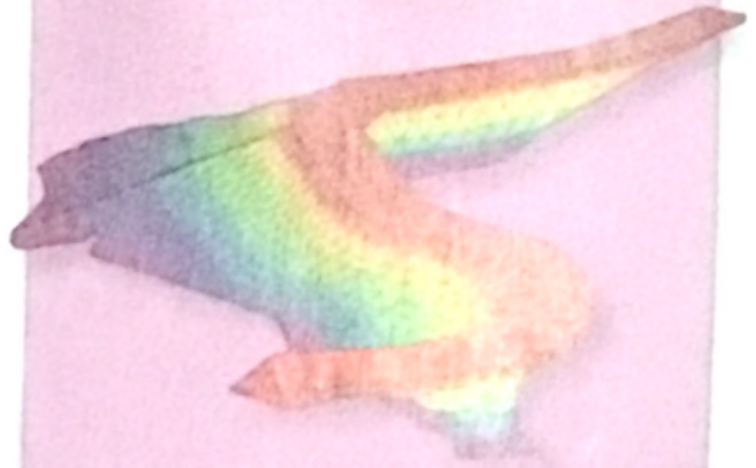
If you viewed Earth from space, you wouldn't see much of the land that makes up Earth's plates. Much of Earth's lithosphere is under oceans and other bodies of water. Look at the Pacific Plate. The western part of California is on this plate, but most of this plate is covered by ocean.

Major Tectonic Plates

- A Pacific Plate
- B North American Plate
- C Cocos Plate
- D Nazca Plate
- E South American Plate
- F African Plate
- G Eurasian Plate
- H Indian Plate
- I Australian Plate
- J Antarctic Plate

Deep cracks in the crust of Iceland show the edges of the North American Plate and the Eurasian Plate.

Like the cracked shell of a boiled egg, Earth's plates rest on a soft solid. Recall that the lower part of the mantle can flow very slowly. The plates of the lithosphere float on top of this layer.



"Seeing" Inside Earth

You might wonder how scientists know so much about the inside of Earth if they can't go there. Earth's interior is just one of the many objects that scientists cannot observe directly. As with other objects they can't see, scientists use indirect evidence to study Earth's interior.

When earthquakes happen, they produce waves that travel through Earth's interior. The waves travel faster through certain kinds of materials than others, but they take only minutes to travel from one part of Earth to another. On their journey, they travel through the mantle.

Scientists can study the travel times of the waves to get clues about the kinds of materials inside Earth. Scientists also use the clues they gather to find out about Earth's plates.

Another way they learn about Earth's interior is to use a process called seismic tomography. Seismic tomography works this way. Scientific stations around the world detect earthquake waves and the collected data is used to make three-dimensional pictures like the one above.

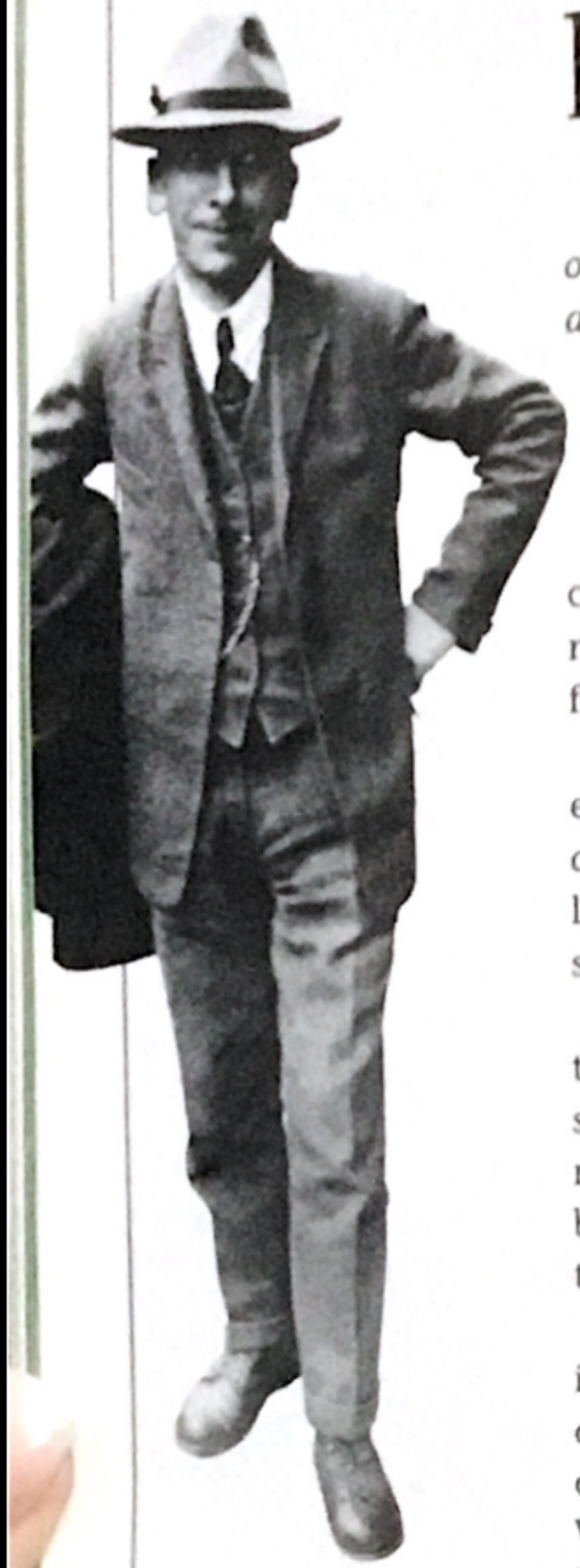
✓Lesson Checkpoint

1. Describe the layers of Earth.
2. On which plate is most of the United States? On which plate is Hawaii?
3. **Writing in Science** **Descriptive** Earth's tectonic plates are often compared to a jigsaw puzzle. Write a paragraph describing how the plates and a jigsaw puzzle are alike and how they are different. Use the words *lithosphere, mantle,* and *crust.*

Lesson 2

How do Earth's plates help create landforms?

Alfred Wegener introduced the idea that the continents drift slowly over Earth's surface. Evidence from fossils, rock types, ancient climates, and seafloor spreading supported this theory.



This is the last picture taken of Alfred Wegener before he left for Greenland in 1930. Wegener died in Greenland during a blizzard.

Continental Drift

Until the early 1600s, most people thought that Earth's continents were always in the same place. Then scientists began to notice that the coastlines of some continents looked as if they could fit together like a jigsaw puzzle. Many people wondered why.

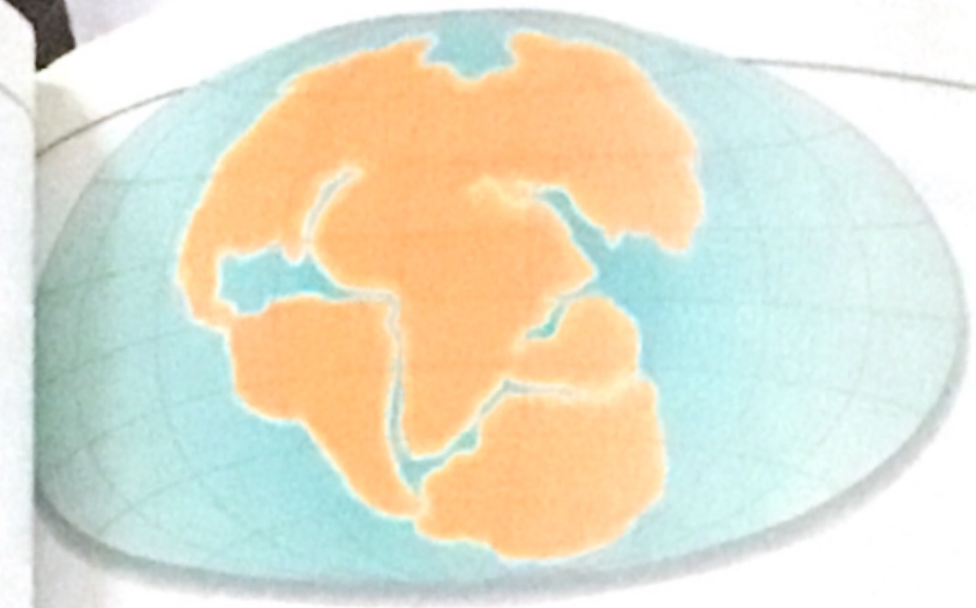
Then in 1912 Alfred Wegener, a German scientist, suggested an explanation for the fit of the coastlines. Wegener thought that about 225 million years ago the continents were joined in one large continent he called Pangaea (meaning "all Earth"). Wegener suggested that long ago Pangaea broke apart.

Wegener also introduced the idea of **continental drift**, the theory that continents drifted apart in the past and continue to do so. A scientific theory is a well-tested concept that explains a wide range of observations. Wegener's theory stated that as Pangaea broke apart, its pieces moved to different parts of Earth to form today's continents.

The shape of continents was evidence for Wegener's ideas, but it wasn't proof. Other evidence supported Wegener's ideas. Plant and animal fossils found along the eastern coast of South America closely matched those found along the western coast of Africa. Wegener felt these similarities were impossible unless the species had once lived side-by-side when the continents were joined.

Further evidence for Wegener's ideas was found in rocks. Layers of rocks along the eastern coast of South America match layers of rocks along the western coast of Africa. Wegener said that the layers of rocks must have been joined at some time.

What forces could be strong enough to move whole continents? This is the question that Wegener could not answer. As a result, most scientists did not believe the idea of continental drift. They thought that the continents did not move, even over millions of years.



200 millon years ago

65 millon years ago

Today

1. **Checkpoint** What was the main reason most scientists did not accept the idea of continental drift?
2. **Writing in Science** **Expository** Wegener offered several types of evidence to support his idea of continental drift. Write a short paragraph that summarizes his evidence.

Fossil Evidence

Among the many bits of evidence for continental drift are two fossils.

Fossils of the ancient plant *Glossopteris* are found in South America, Africa, India, Antarctica, and Australia. These identical plants could only develop at places that were connected at some time in the past. In addition, *Glossopteris* fossils were also found in very cold regions of Earth. When the plants grew, these regions must have been located at warmer parts of Earth.

Fossils of this ancient reptile, called *Mesosaurus*, have also been found in both South America and Africa. This freshwater animal could not have survived a trip across a saltwater ocean. Wegener claimed the reptile must have walked from one area to the other when the continents were connected.

The Spreading Ocean Bottom

This map shows the Atlantic Ocean floor. You can see the Mid-Atlantic Ridge.

Not much other evidence supported Wegener's theory of continental drift. Later, better methods to map the ocean floor were developed. Scientists then collected data that showed long, deep ocean trenches. They also discovered a chain of mountains along the floor of the Atlantic Ocean. These mountains are now called the Mid-Atlantic Ridge.

In 1960 scientist Harry Hess offered an explanation for the trenches and ridges. He suggested that new crust forms at ocean ridges. He explained that magma, which is molten rock, pushes up through Earth's crust. As the magma cools, it forms new crust. More magma comes up and pushes the newly formed crust and the old crust aside. This process is known as seafloor spreading.

What causes the magma to rise? As Earth's plates move away from each other, the ocean floor spreads apart, and magma rises to fill the gap. But what causes the plates to move apart?

In the early 1930s, Arthur Holmes had developed ideas that scientists used in the 1960s to answer the question. When a liquid is heated, particles that make up the liquid move faster and spread apart. Hot liquids therefore weigh less and float above cooler liquids. As the hot liquid rises and cools, it becomes heavier and again sinks. More hot liquid can then rise above it. This process is called convection. The mantle is not a flowing liquid, but its rocks are so hot that they flow very slowly. The result is that currents in the mantle constantly rise, circle around, and fall. When the mantle moves, the plates floating on it also move. Convection is the force that moves Earth's plates.

Convection currents in the mantle cause the plates to move.

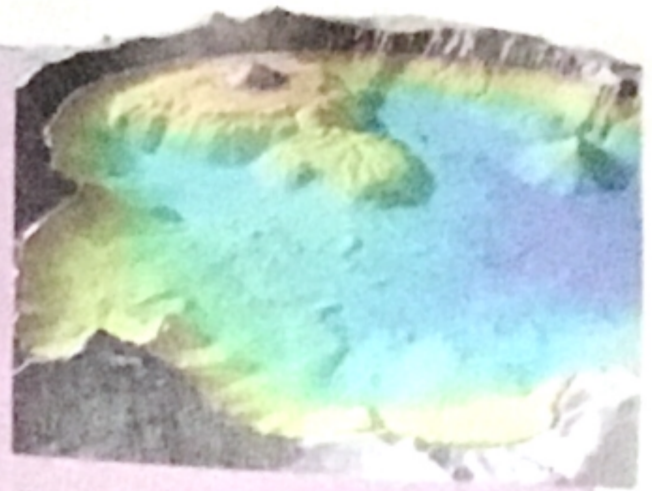
Proof of Continental Drift

Although the explanation for sea floor spreading helped to support Wegener's ideas, scientists needed more proof of continental drift. In the early 1960s, scientists studying the magnetism of rocks near the Mid-Ocean Ridge noticed a pattern. In some places the magnetism faced north. In other places, it faced south. Scientists found alternating rows of north/south patterns spreading out from the Mid-Ocean Ridge. What did this evidence mean?

Earth's magnetism "flips" about every half million years. When rocks form from the cooling lava of volcanoes, the particular magnetic pattern at the time is "frozen" into the rocks. This was evidence that the alternating pattern of the rock has been slowly spreading out as new crust is formed.

✓Lesson Checkpoint

1. Why do hot liquids float above cool liquids?
2. **Math in Science** A ship emits sound waves straight down toward the ocean floor. The waves take 2.1 seconds to reflect back to the ship. If the speed of sound in ocean water is about 1500 meters per second, how deep is the ocean at that point?
3. **Writing in Science** **Persuasive** Suppose you have a friend who doesn't believe that continental drift occurs. Write one or two paragraphs explaining the concept and why you believe it is true.

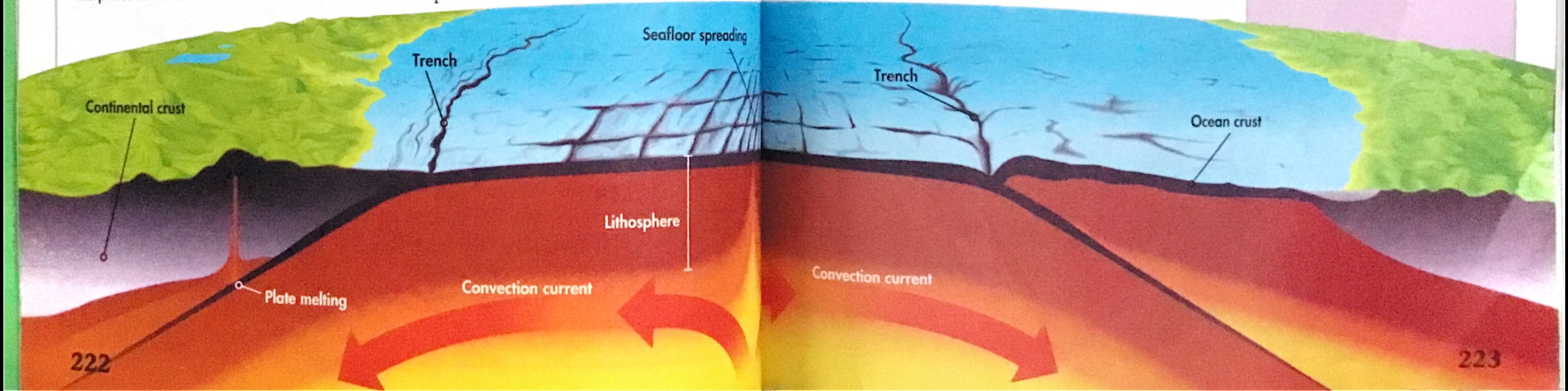


Sonar

Have you ever heard an echo? You might be surprised to know that scientists use echoes to map the ocean floor.

Beginning in the early 1900s, scientists began to use sound waves to learn about the ocean floor. Sonar, which stands for **SO**und **N**avigation **A**nd **R**anging, is a method of bouncing sound waves off objects and measuring the time it takes for the waves to return to where they started. Sonar is used mainly underwater, such as in the ocean.

Today scientists use different methods to send sounds and detect their return in the ocean. On their return, the sound waves enter a computer, where they produce electrical signals. The computer uses the information about time differences of the echoes to make an image of the ocean floor, similar to the picture above, which shows the floor of Crater Lake, Oregon.



Lesson 3

How do scientists explain Earth's features?

The theory of plate tectonics explains features such as mountains and volcanoes. Convection currents in the mantle cause Earth's plates to move. Plates can slide past each other, collide, or move away from each other.

Theory of Plate Tectonics

Wegener's idea of continental drift suggested that continents moved, but it did not explain many other parts of Earth's crust. Today scientists use the theory of **plate tectonics** to explain why Earth's features appear as they do.

According to the theory of plate tectonics, Earth's lithosphere is broken into about 20 moving plates. The continents and the ocean floor make up the surfaces of these moving plates.

Earth in the Future

The map shows how Earth will possibly look 50 million years from now.

- **A** The Atlantic Ocean will widen.
- **B** The part of California that lies on the Pacific Plate will move north.
- **C** North America and South American will split apart.
- **D** Africa and Asia will no longer be joined.
- **E** Parts of eastern Africa may become an island.
- **F** Australia will move northward and collide with Indonesia.

Earth's plates move in a continuous process in different directions—away from, alongside, or toward each other. How do scientists know how the plates move?

Scientists can figure out how the plates move by receiving radio signals from Global Positioning System (GPS) satellites in space to determine the precise distance between points on different plates and how the distances change over time. For example, they know from data they have collected that the North American Plate and the Eurasian Plate are moving about two centimeters a year away from each other.

The theory of plate tectonics explains many of Earth's features. Continents may break apart. Mountain chains may form where plates move together. As plates move apart, magma may rise to the surface, forming a volcano. Oceans may become larger or smaller. Throughout Earth's history, the positions of the land and the oceans have changed from the ancient Pangaea to the modern-day continents. Earth's plates will continue to move in the future.

The map shows where scientists predict the continents will be 50 million years from now. You might wonder how scientists can make this prediction. Evidence shows that plate movement has always taken place at about the same rate. And scientists predict that the plates will continue to move. They think it is possible that in the far distant future, the continents could come together once again to create another Pangaea-like continent.

1. **Checkpoint** How does the theory of plate tectonics differ from Wegener's idea of continental drift?
2. **Draw Conclusions** The map on page 224 shows where scientists think Earth's continents will be in 50 million years. What conclusion can you draw about the movement of North America after that?

Molten rock cools and hardens, forming new crust.

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Plate Boundaries

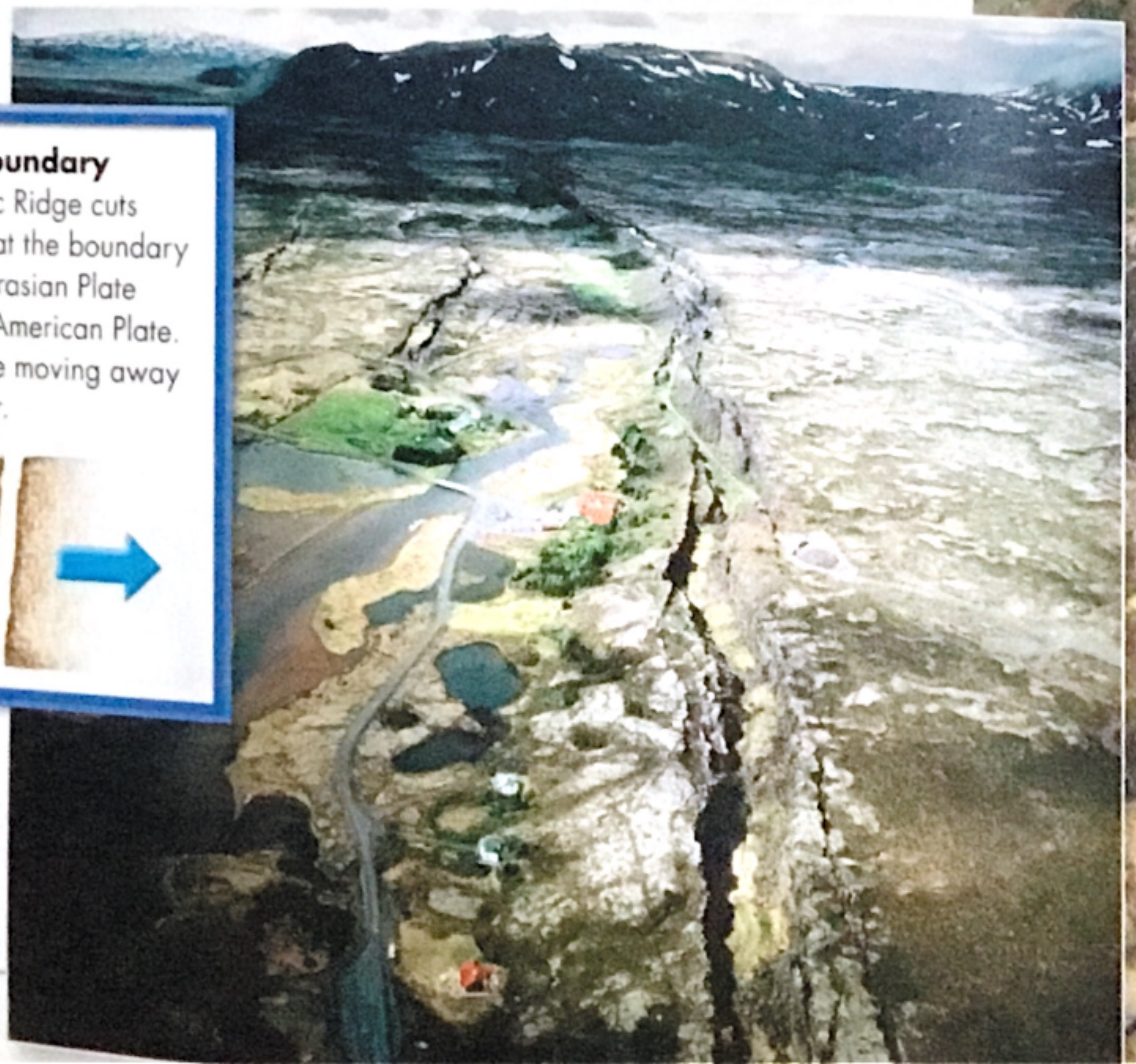
The pictures on this page show **plate boundaries,** areas where two plates meet. Plates move slowly in different directions. They may move apart, they may collide, or they may slide past each other. You can see the landforms that result as changes slowly happen at each kind of plate boundary.

At spreading boundaries, plates move away from each other and gaps form between the plates. Convection currents cause magma to rise from the mantle through these gaps. Huge valleys can form. This type of plate movement is responsible for seafloor spreading. The Mid-Atlantic Ridge formed at plate boundaries that were moving apart.

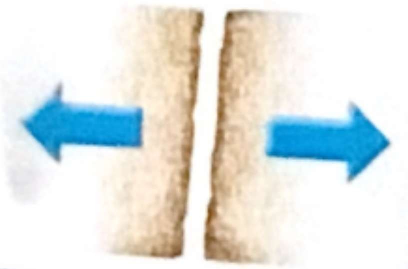
At fracture boundaries, plates slide past each other. This break in Earth's crust is called a **fault.** The movement of the plates past each other can cause strong earthquakes.

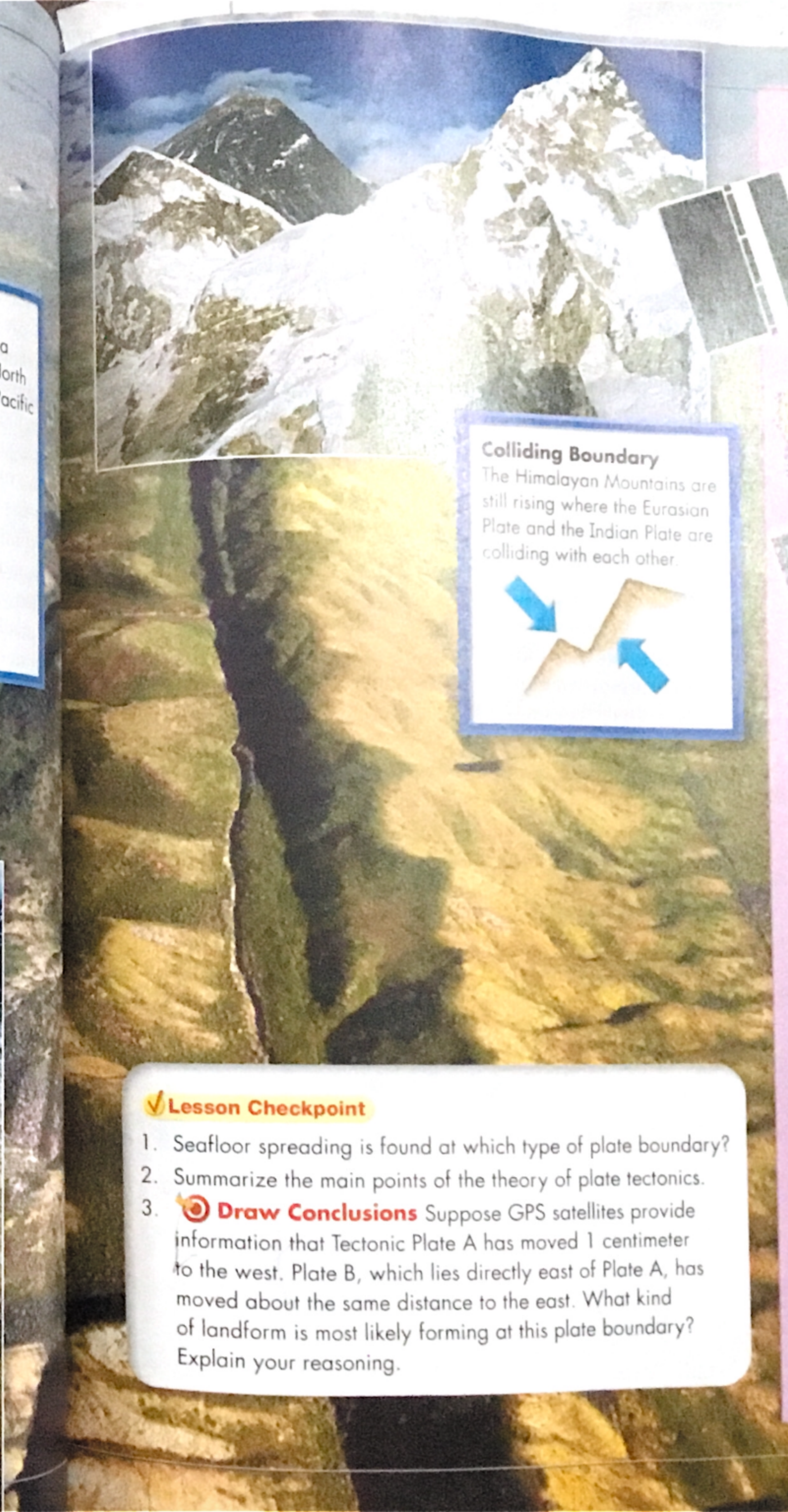
The area where two plates push against each other is called a colliding boundary. When plates collide, one plate might slide beneath the other. When plates carry continents into each other, towering mountains form. Other times, deep ocean trenches, earthquakes, and volcanoes can result.

Fracture Boundary
The San Andreas fault is a boundary between the North American Plate and the Pacific Plate. The two plates are sliding past each other.



Spreading Boundary
The Mid-Atlantic Ridge cuts across Iceland at the boundary between the Eurasian Plate and the North American Plate. These plates are moving away from each other.





Colliding Boundary
The Himalayan Mountains are still rising where the Eurasian Plate and the Indian Plate are colliding with each other.

GPS

How do scientists know how fast Earth's plates move? One method they use is the Global Positioning System (GPS).

The Global Positioning System is a group of 24 satellites, like the one above, in orbit over Earth. These satellites continually give off radio signals that can be picked up by GPS receiving units on Earth. By comparing signals from the GPS satellites, the position, speed, and direction of motion of a receiver can be figured out.

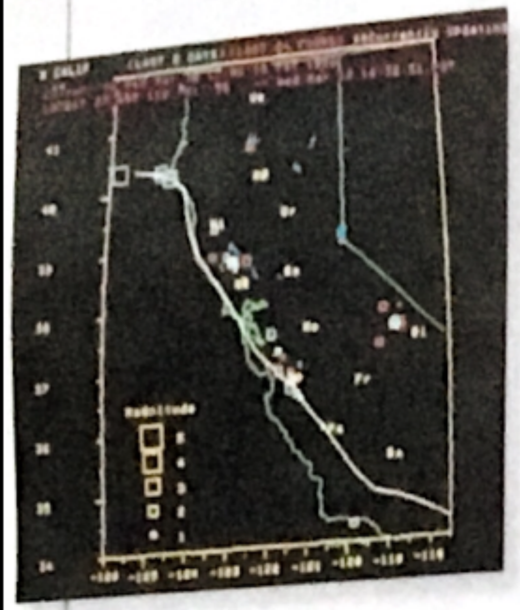
Scientists have placed GPS receivers at many different places on Earth to measure their precise position. By comparing measurements over time, scientists can determine the speed and direction of Earth's tectonic plates.

✓ Lesson Checkpoint

1. Seafloor spreading is found at which type of plate boundary?
2. Summarize the main points of the theory of plate tectonics.
3. **Draw Conclusions** Suppose GPS satellites provide information that Tectonic Plate A has moved 1 centimeter to the west. Plate B, which lies directly east of Plate A, has moved about the same distance to the east. What kind of landform is most likely forming at this plate boundary? Explain your reasoning.

Lesson 4

What causes earthquakes and volcanoes?



Scientists study the vibrations within Earth's crust to learn about earthquakes. This map shows the earthquake activity in California in a 24-hour period.

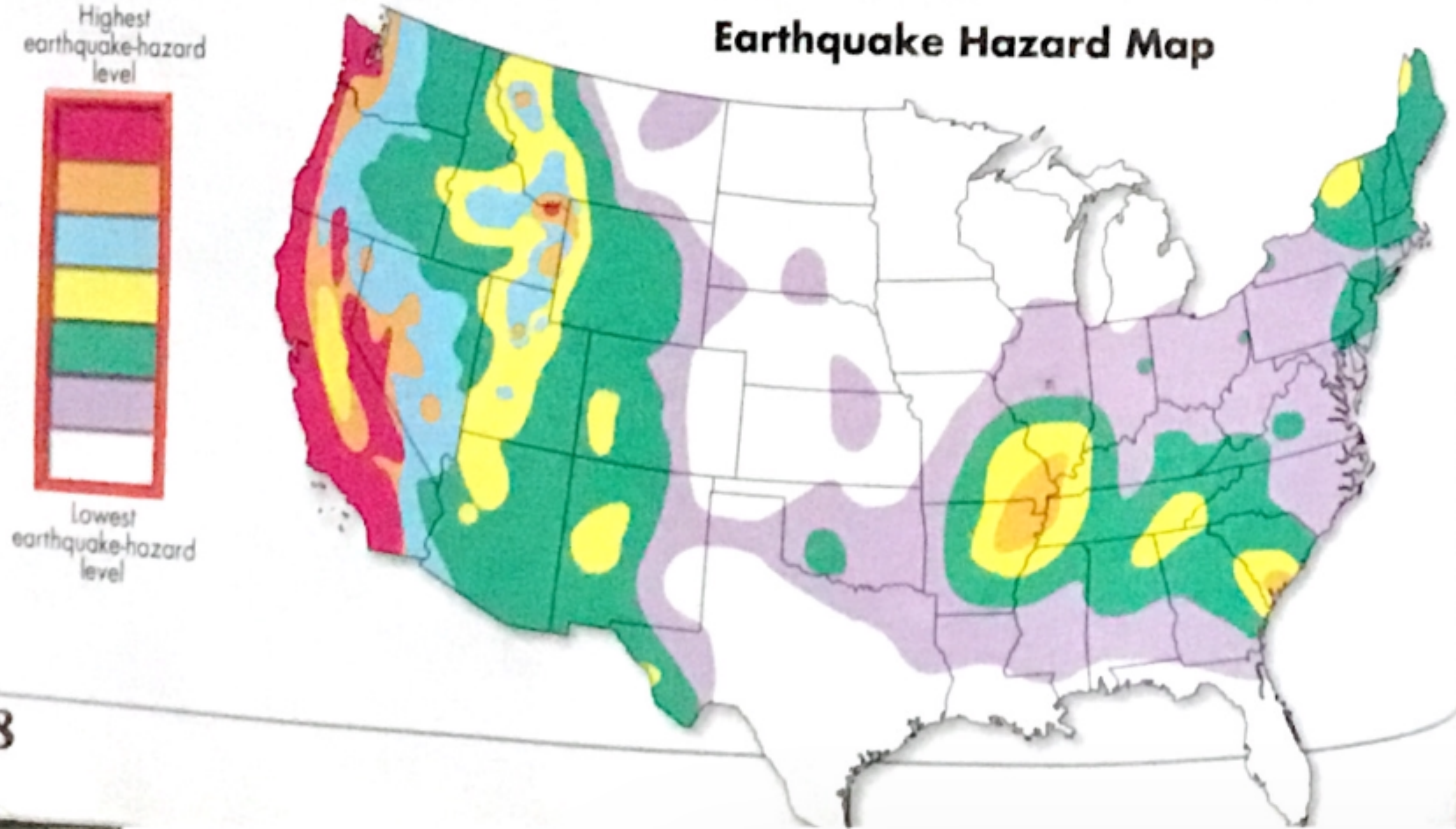
Earthquakes are caused by the sudden shifting of rock as tectonic plates shift positions. Volcanoes occur where magma from the mantle either flows or explodes through the crust.

Earthquakes

Plate movement takes place so slowly that you can't see or feel it. In fact, some plates don't move for many years. Jagged rock edges in the lithosphere sometimes stop the movement. Over time, pressure builds up, until suddenly the pressure is too strong. The rocks lurch forward. Earth's crust shakes—an earthquake has happened!

Earthquakes cause damage when the pressure that builds up along a fault is suddenly released. The underground point where the earthquake occurs is called the focus. The point on Earth's surface directly over the focus is called the epicenter.

The energy from an earthquake is carried by waves. The waves spread out from the focus and from the epicenter. Some waves cause the ground to move back and forth. Other waves cause the ground to move up and down or in a circular motion.



Earthquake Magnitude

As the waves spread out, they lose energy. The possibility of earthquake damage, therefore, is greatest closest to the epicenter. Most damage often occurs to nearby construction, such as highways and buildings.

Almost all of the major earthquakes in the United States have occurred in California and Alaska. These states are on the plate boundary between the Pacific Plate and the North American Plate. Most earthquakes take place near the edges of plates.

The map on page 228 shows earthquake hazard—how likely an area is to have earthquakes—for different parts of the United States. As you can see, the highest levels are along the west coast.

The strength of an earthquake is given as its magnitude. An earthquake magnitude scale is a series of numbers. The number shows the total amount of energy released. The Richter scale is one such scale. Each increase of 1 on the scale indicates about 31 times more energy is released. The table shows the magnitude of some earthquakes and the number of people killed. Notice that the magnitude of an earthquake doesn't always indicate how much damage will result. The effect of an earthquake depends on many factors, including the size of the earthquake, its distance from the epicenter, the kind of rock in the area, and the types of buildings there.

The energy of an earthquake caused the damage to this freeway in Los Angeles, California.

Earthquakes

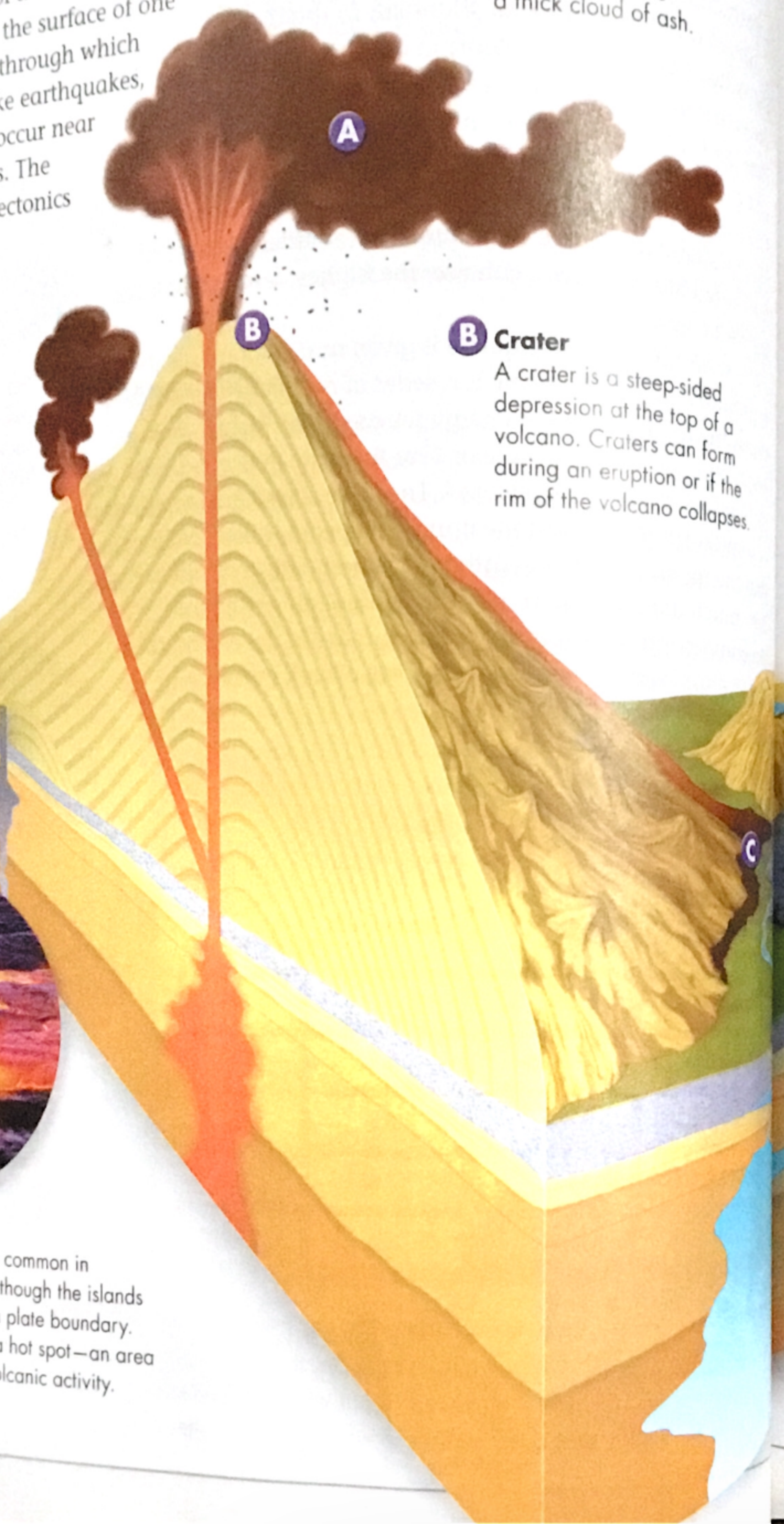
Date	Place	Magnitude	Total deaths
1/22/2003	Mexico	7.6	29
3/29/2003	Afghanistan	5.9	1
5/27/2003	Algeria	5.8	9
9/27/2003	Russia	7.3	3
12/26/2003	Iran	6.6	30,000

The 1999 earthquake that caused this damage in Turkey caused many buildings to collapse.

1. **Checkpoint** How is an earthquake's epicenter related to its focus?
2. **Art in Science** When earthquakes occur, they produce two kinds of waves—S waves and P waves. Find out what these waves are. Make a visual display that describes these waves and how they travel.

Volcanoes

Picture a tall, cone-shaped mountain with thick, glowing matter spewing from it. The picture in your mind is of a volcano. A volcano is an opening in the surface of one of Earth's plates through which magma rises. Like earthquakes, most volcanoes occur near plate boundaries. The theory of plate tectonics explains why.



A Ash Cloud
Tiny bits of rock spew into the air during an eruption, forming a thick cloud of ash.

B Crater
A crater is a steep-sided depression at the top of a volcano. Craters can form during an eruption or if the rim of the volcano collapses.

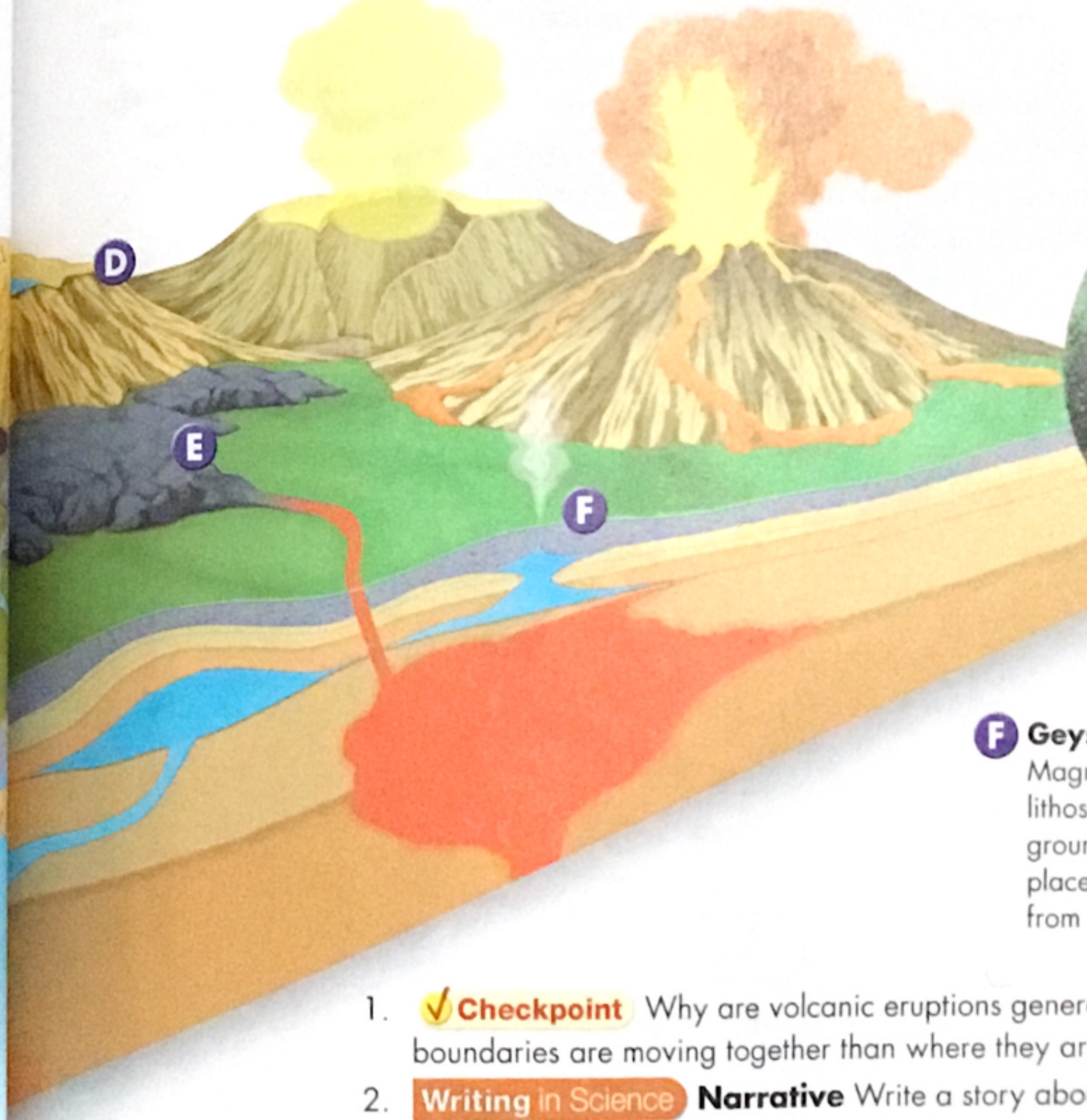
Volcanic rock

C Hot Spot
Volcanoes are common in Hawaii, even though the islands are not near a plate boundary. Hawaii is on a hot spot—an area of on-going volcanic activity.

When one plate sinks beneath another at a plate boundary, the sinking crust melts into magma. Pressure can build up from gases trapped in the magma—somewhat like the pressure that builds when you shake a can of carbonated beverage. If the crust of the overlying plate can no longer withstand the pressure, magma explodes through it as a volcano. Magma that reaches the surface is called lava.

Volcanoes are more common than you might think. That's because you never hear about most volcanoes. They take place where plate boundaries are moving away from each other on the ocean floor. Magma quietly flows out onto the ocean floor. New crust forms from the cooled lava.

D Caldera
A caldera is a crater that is at least 1.6 km wide. A lake may form in a caldera. The 9.6 km wide Crater Lake in Oregon formed in a caldera of the Cascade Mountain Range.



E Basalt plain
Flows of lava spill out onto nearby ground forming new crust. Basalt is a dark volcanic rock.

F Geyser
Magma trapped in the lithosphere can heat groundwater. In some places, the steam spews from the crust.

1. ✓ **Checkpoint** Why are volcanic eruptions generally more violent where boundaries are moving together than where they are moving apart?
2. **Writing in Science** **Narrative** Write a story about being a speck of magma inside a volcano. Explain what happens as pressure within the volcano builds up.

Predicting Volcanoes and Earthquakes

If an earthquake or volcano was threatening the area where you live, you'd want to know as soon as possible. Can scientists predict these potential disasters?

Scientists can use a variety of tools to make predictions about when and where volcanoes and earthquakes will happen. Seismometers, such as the ancient one below, detect tremors, or shaking movements in Earth's crust. The tremors may be a signal that magma is rising in a volcano or that Earth's plates are shifting. Another instrument, a tiltmeter, detects changes in the slope of the land. This change also tells scientists that magma is rising within a volcano.

Scientists can often predict where and when volcanoes will erupt. Maps show where past activity has occurred. They give clues to where future activity is likely to occur because volcanoes often have a pattern of eruption.

Predicting earthquakes isn't as easy as predicting volcanoes. Scientists can find the location of faults, but how can they know when plates will suddenly shift? Scientists listen for tremors, using an instrument called a seismograph. A free-moving part of the seismograph moves freely back and forth as the ground moves. The instrument records this movement.

Seismograph

The first instrument used to predict earthquakes was invented in China in A.D. 132.

Small shifts in ground level would cause a ball in a dragon's mouth to fall into a frog's mouth. The frog that contained the ball would indicate the direction from which the earthquake occurred.

Preparing for Earthquakes

The best way to avoid earthquake damage and harm to your body is to be prepared. For example, people who live in an area at high risk for earthquakes can safeguard their home. The diagram shows some ways to do this. Be sure to read the other tips for earthquake safety on this page.

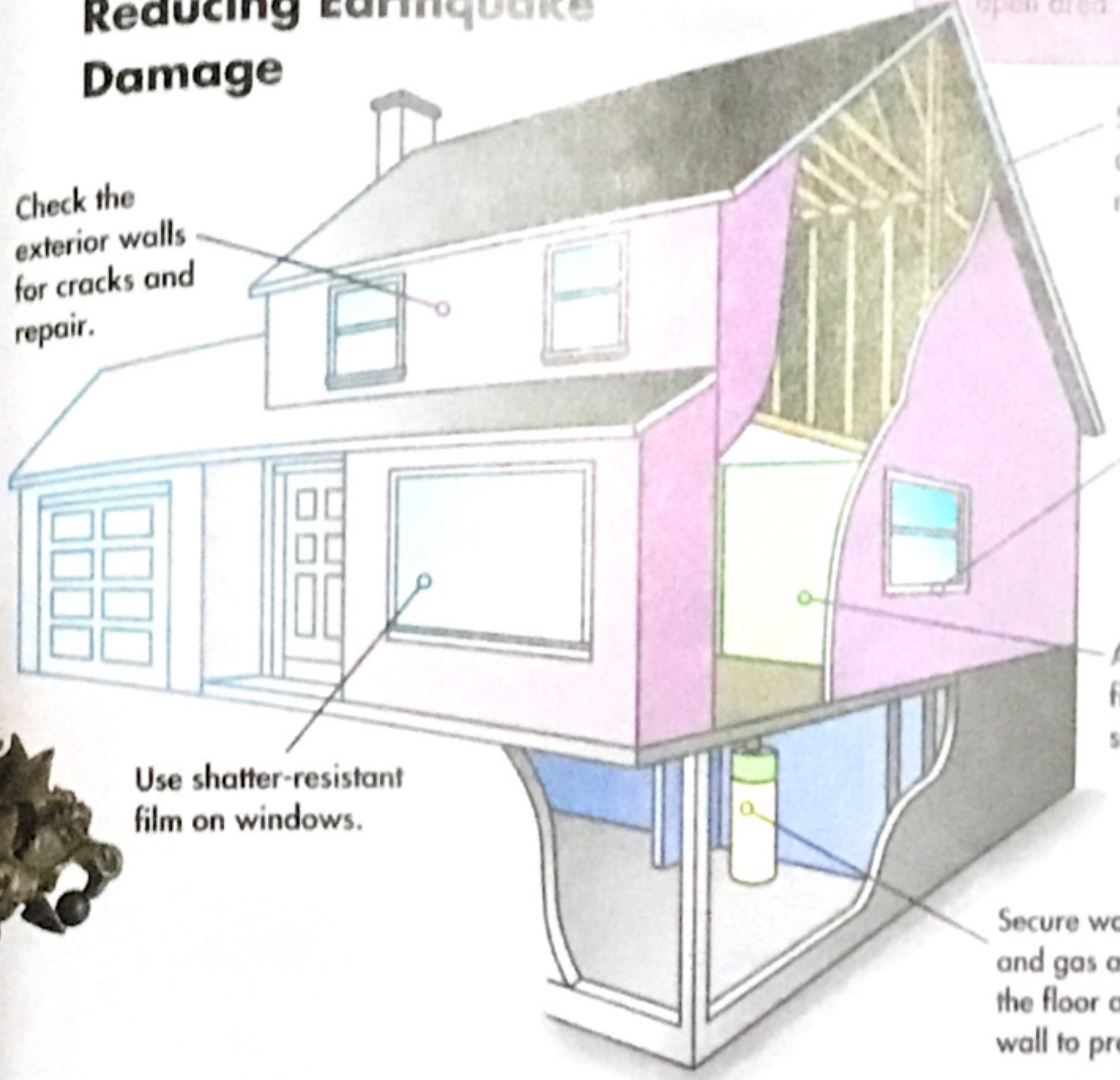
Earthquake Safety

Here are some tips to help keep you safe during an earthquake.

Before an earthquake:
- Make a family safety plan.

During an earthquake:
- If you are inside, get under a table or desk.
- Stay away from objects that might fall.
- If you are outside, stay away from buildings and move to an open area.

Reducing Earthquake Damage



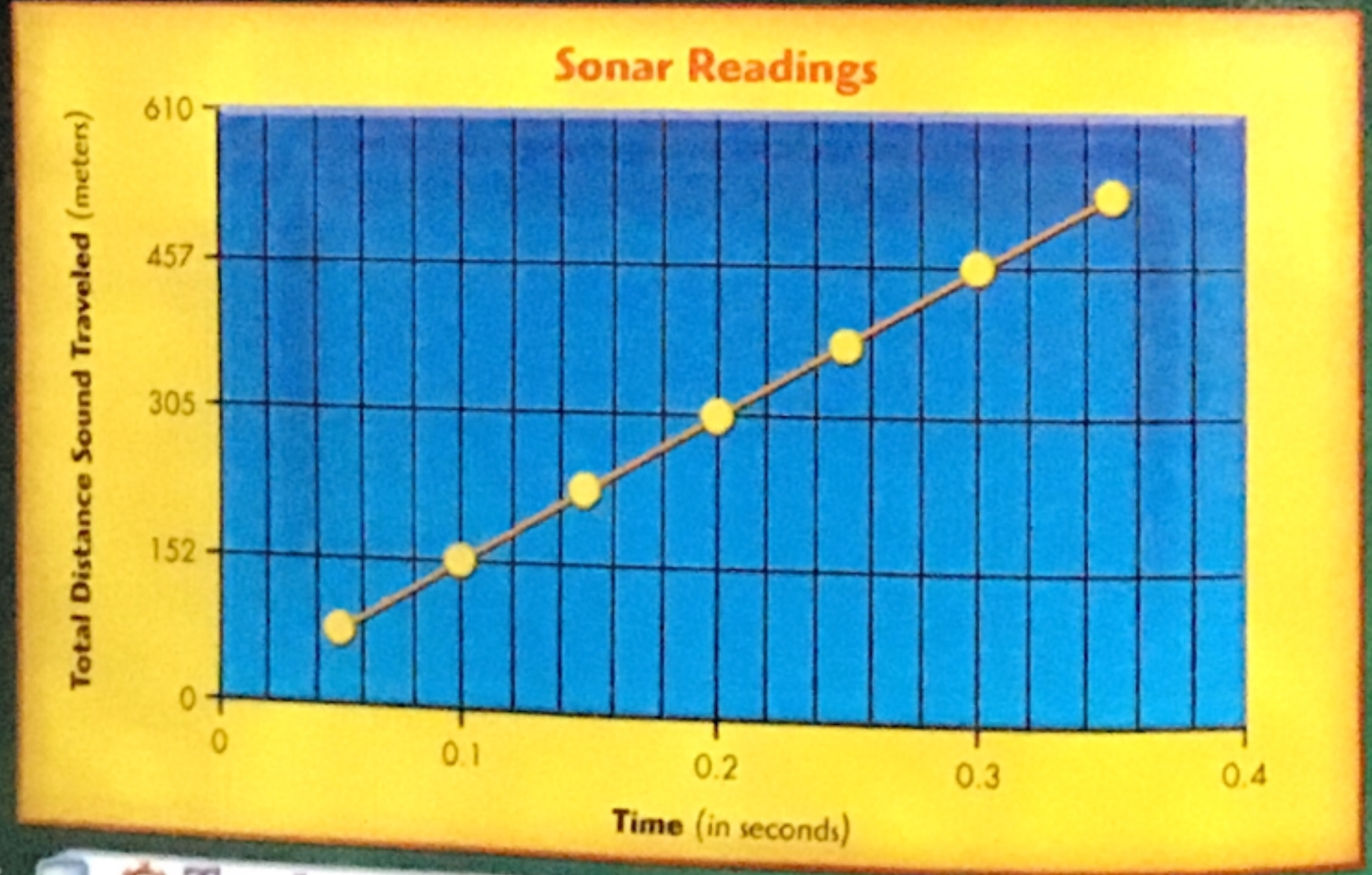
✓ Lesson Checkpoint

1. What causes an earthquake?
2. What should you do during an earthquake?
3. **Writing in Science** **Descriptive** Go to a government Web site, such as FEMA or USGS, and find out how to prepare for an earthquake. Use the information to write a family safety plan for your own family or other families who live in earthquake areas.

Math in Science

Fishing with Sound

Fishermen like to know where the fish are. The problem is that people can't see far into the water. For us to see something, light must bounce off it and travel to our eyes. Light does not travel well through water, so we can't see clearly in water. Sonar equipment uses sound to let us "see" in places that light cannot easily travel, like underwater. Special sounds, called pings, are sent from the boat toward the bottom of the body of water. When these sound waves hit something, like the bottom or a school of fish, they reflect back to the boat, and a computer can turn the reflected waves it receives into a picture. The line graph below contains sonar data recorded in freshwater. Each point on the graph represents one ping.



Use the graph on page 236 to answer each question.

1. For sound waves, what is the relationship between distance traveled and time?
2. How far did a ping travel in three tenths of a second?
3. A ping must travel down to an object and then back to the boat. If a ping travels 300 meters, how deep is the object from which it was reflected?
4. For what amount of time should a ping travel if you were looking for fish that swim at a depth of about 75 meters?
5. Sound travels through freshwater more slowly than through salt water. Predict how the sonar graph would change in salt water. Explain.
6. Predict how far a ping would travel in one half of a second. How did you make your prediction?

Lab zone Take-Home Activity

Make some measurements of distance as it relates to time. For example, measure the distance a model car travels in 10 seconds, 20 seconds, and so on. Make a line graph with your data. Is there a clear relationship between time and distance? If you think so, try making a prediction for another time period and see if your prediction holds true.

Chapter 8 Review and Test Prep

Use Vocabulary

continental drift (p. 220)	**lithosphere** (p. 218)
core (p. 216)	**mantle** (p. 216)
crust (p. 216)	**plate boundary** (p. 226)
fault (p. 226)	**plate tectonics** (p. 224)

Write the term from the list above that best completes each sentence.

1. The theory of _____ explains how the lithosphere is broken into moving plates that float on a layer of partly melted rock.
2. The place where two plates meet is called a _____.
3. Wegener proposed the idea of _____ to explain why continents seem to fit together like a jigsaw puzzle.
4. Most of Earth's mass is in the _____.
5. The part of Earth we live on is the _____.
6. Many earthquakes occur in southern California because of a large _____ in the crust.
7. Earth's crust and part of the upper mantle make up the _____.
8. The lower part of the _____ is under such pressure that it is solid, even though it is at an extremely high temperature.

Explain Concepts

9. Explain the process of convection.
10. How does plate tectonics explain the formation of mountains?
11. The pictures show two fossils—*Glossopteris*, an ancient plant, and *Mesosaurus*, an ancient reptile. Explain how these fossils can be used as evidence for continental drift.

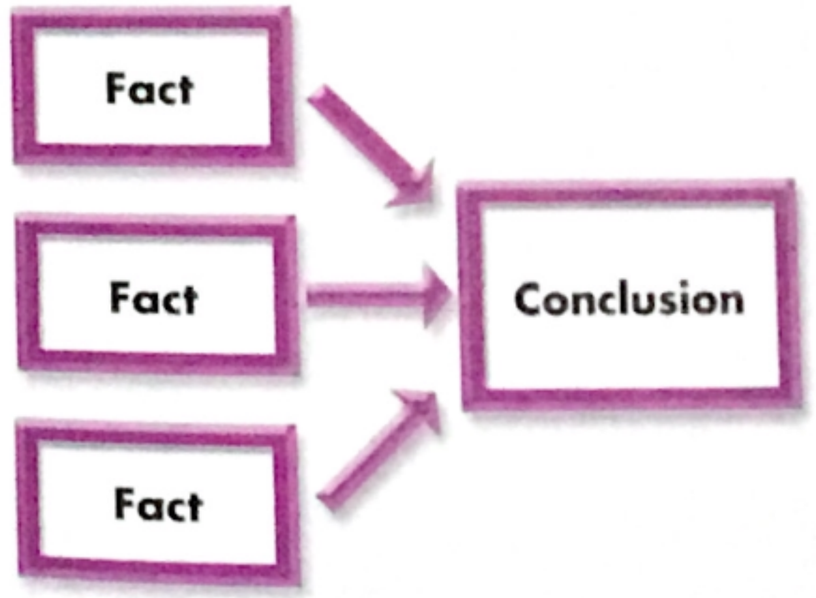
12. Describe the sequence of events that led scientists to finally accept the idea of continental drift.

Process Skills

13. **Infer** what would happen if Earth's convection currents in Earth's mantle slowed down.
14. **Observe** Look around your home and school. What are some safety measures you could take to protect yourself if an earthquake happens?

Draw Conclusions

15. You are a scientist monitoring a series of instruments near a particular location. Your tiltmeter tells you that the slope of the land is changing. The seismometer indicates that tremors are getting larger. What would you conclude from this information? Use a graphic organizer like the one below to answer the questions.



Test Prep

Choose the letter that best completes the statement or answers the question.

16. Which of Earth's layers contains convection currents that move the tectonic plates?
    Ⓐ upper mantle
    Ⓑ lower mantle
    Ⓒ outer core
    Ⓓ inner core
17. Which scientist proposed the idea of continental drift?
    Ⓕ Hess
    Ⓖ Holmes
    Ⓗ Matthews
    Ⓘ Wegener
18. Which of these is the best evidence of seafloor spreading?
    Ⓐ ocean ridges
    Ⓑ mid-ocean mountains
    Ⓒ volcanic islands
    Ⓓ ocean trenches
19. Explain why the answer you chose for Question 18 is best. For each of the answers you did not choose, give a reason why it is not the best choice.
20. Writing in Science **Expository** Explain what happens as Earth's plates move away from each other.