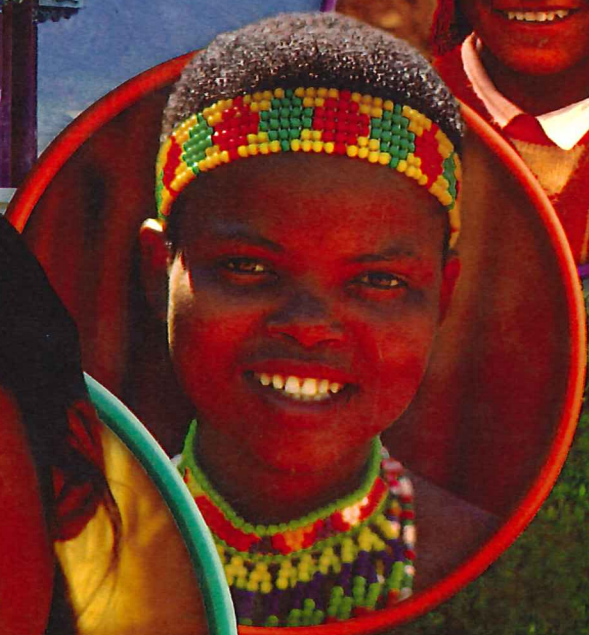
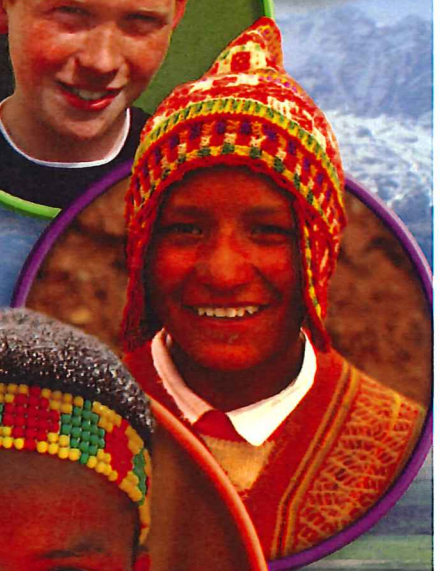


McDougal Littell

World Cultures *and* GEOGRAPHY



Atlas by
 RAND McNALLY



CHAPTER
2

Earth's Interlocking Systems

1

GEOGRAPHY

The Earth and Its Forces

2

GEOGRAPHY

Bodies of Water and Landforms

3

GEOGRAPHY

Climate and Vegetation

4

GEOGRAPHY

Environmental Challenges



ESSENTIAL QUESTION

How do Earth's physical systems make life on Earth possible?

CONNECT

Geography & History

Use the map and the time line to answer the following questions.

1. On which plate does most of the United States sit?
2. Which event on the time line is supported by the evidence on this map?

Geography

1883 Volcanic eruption destroys two-thirds of Krakatoa Island, Indonesia.

1500

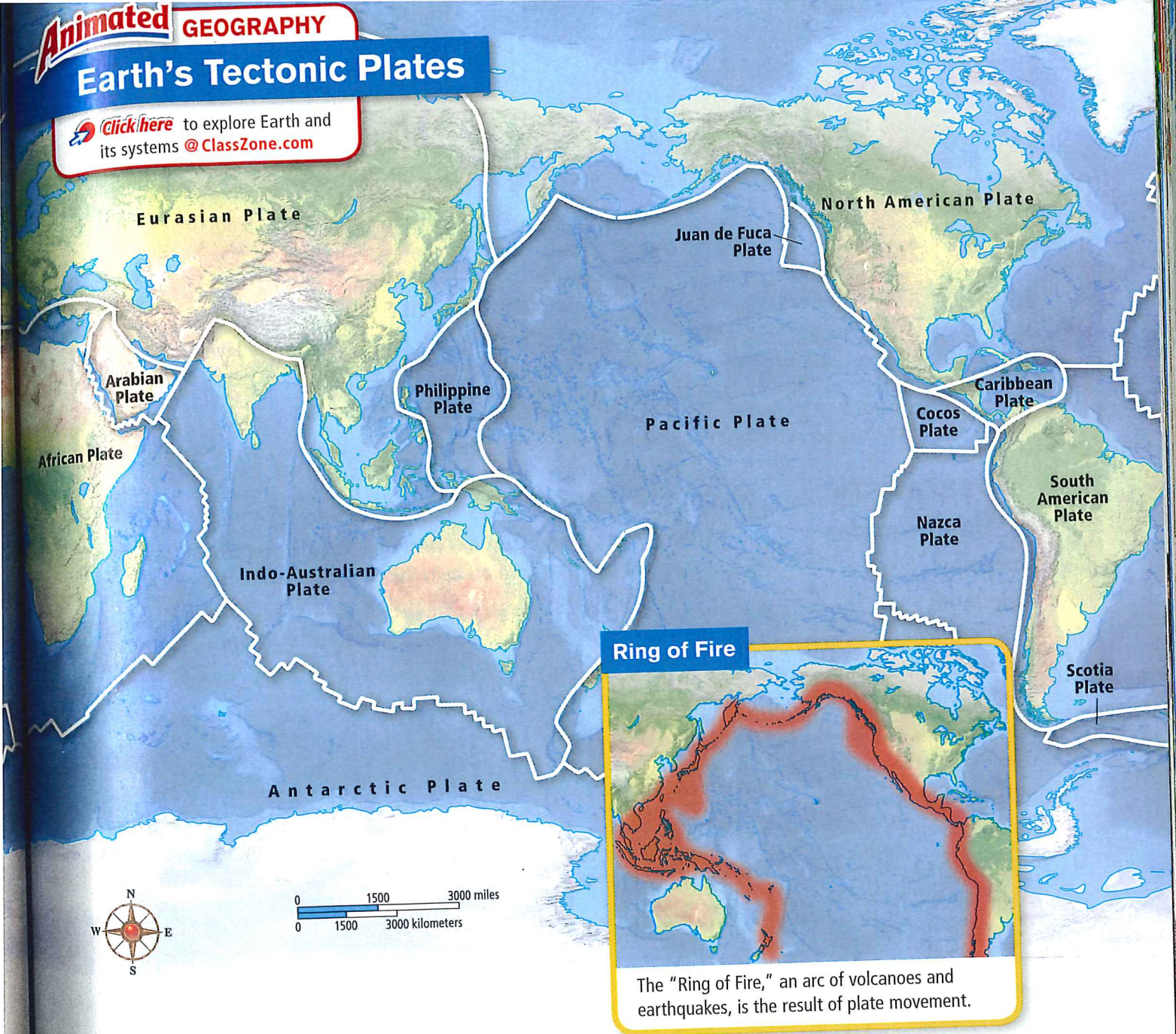
Geography

1620 English philosopher Francis Bacon suggests the continents were once a supercontinent. ▶

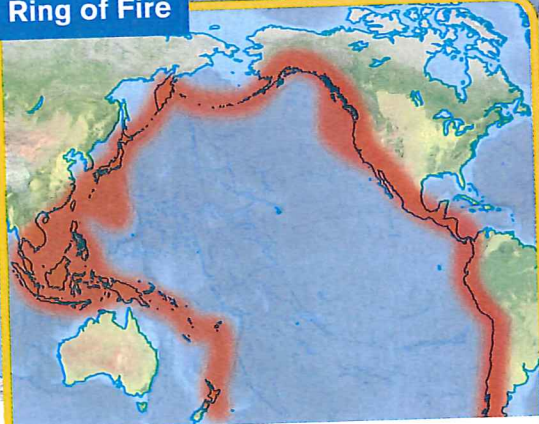


Earth's Tectonic Plates

[Click here](#) to explore Earth and its systems @ [ClassZone.com](#)



Ring of Fire



The "Ring of Fire," an arc of volcanoes and earthquakes, is the result of plate movement.

Geography

1960s Scientists prove that the Earth's crust is broken into moving plates.

History

1912 Continental drift theory proposed

History

1980 Mount St. Helens erupts in Washington and causes world's largest landslide.

Today

History

2004 Indian Ocean earthquake and tsunami kill more than 280,000.

SECTION
1

Reading for Understanding

▶ Key Ideas

BEFORE, YOU LEARNED

Geographers use technology to learn about physical processes on Earth.

NOW YOU WILL LEARN

The Earth is composed of many layers. Its surface continually changes because of the drifting of its plates.

▶ Vocabulary

TERMS & NAMES

magma molten rock

continent one of seven large landmasses on the Earth's surface

tectonic plate a large rigid section of the Earth's crust that is in constant motion

earthquake a sudden movement of the Earth's crust followed by a series of shocks

Ring of Fire a zone of volcanoes around the Pacific Ocean

volcano an opening in the Earth's crust from which molten rock, ash, and hot gases flow or are thrown out

weathering the gradual physical and chemical breakdown of rocks on the Earth's surface

erosion the wearing away and movement of weathered materials by water, wind, or ice

sediment pieces of rock in the form of sand, stone, or silt deposited by wind, water, or ice

glacier a large, slow-moving mass of ice



Visual Vocabulary glacier

▶ Reading Strategy

Re-create the chart shown at right. As you read and respond to the **KEY QUESTIONS**, use the chart to organize important details about the external and internal forces shaping the Earth.



Skillbuilder Handbook, page R7

CATEGORIZE

INTERNAL FORCES	EXTERNAL FORCES
1.	1.
2.	2.
3.	3.
4.	4.



GRAPHIC ORGANIZERS

Go to Interactive Review @ ClassZone.com

The Earth and Its Forces

Connecting to Your World

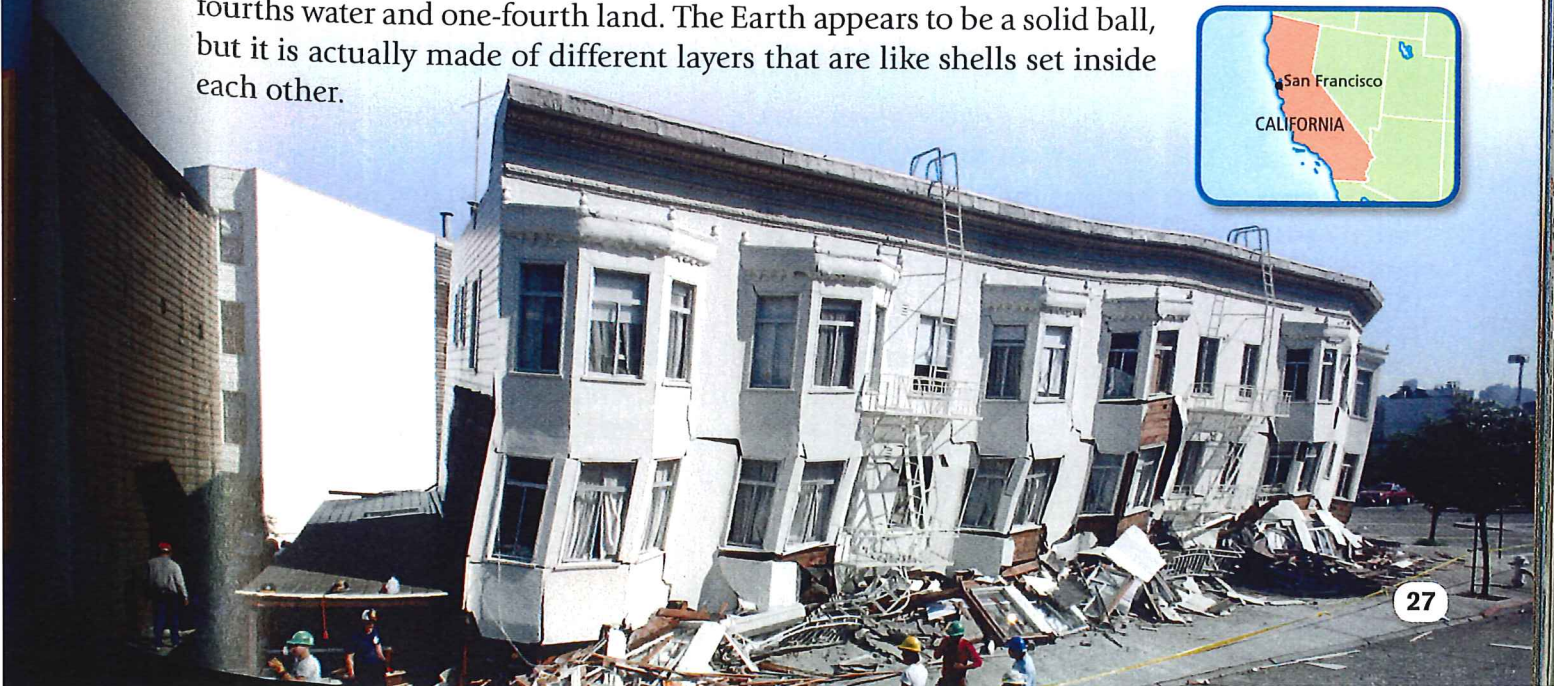
Have you ever experienced an earthquake or the eruption of a volcano? Probably not. But you may have seen these events on television. Perhaps you saw the coverage of the great earthquake in Indonesia on December 26, 2004. Hundreds of thousands of people were killed or displaced by this earthquake and the tsunami, or great wave, it caused. Earthquakes and volcanoes are just two of the many forces that change the Earth's surface.

Internal Forces Shaping the Earth

KEY QUESTION How is the Earth's surface shaped by internal forces?

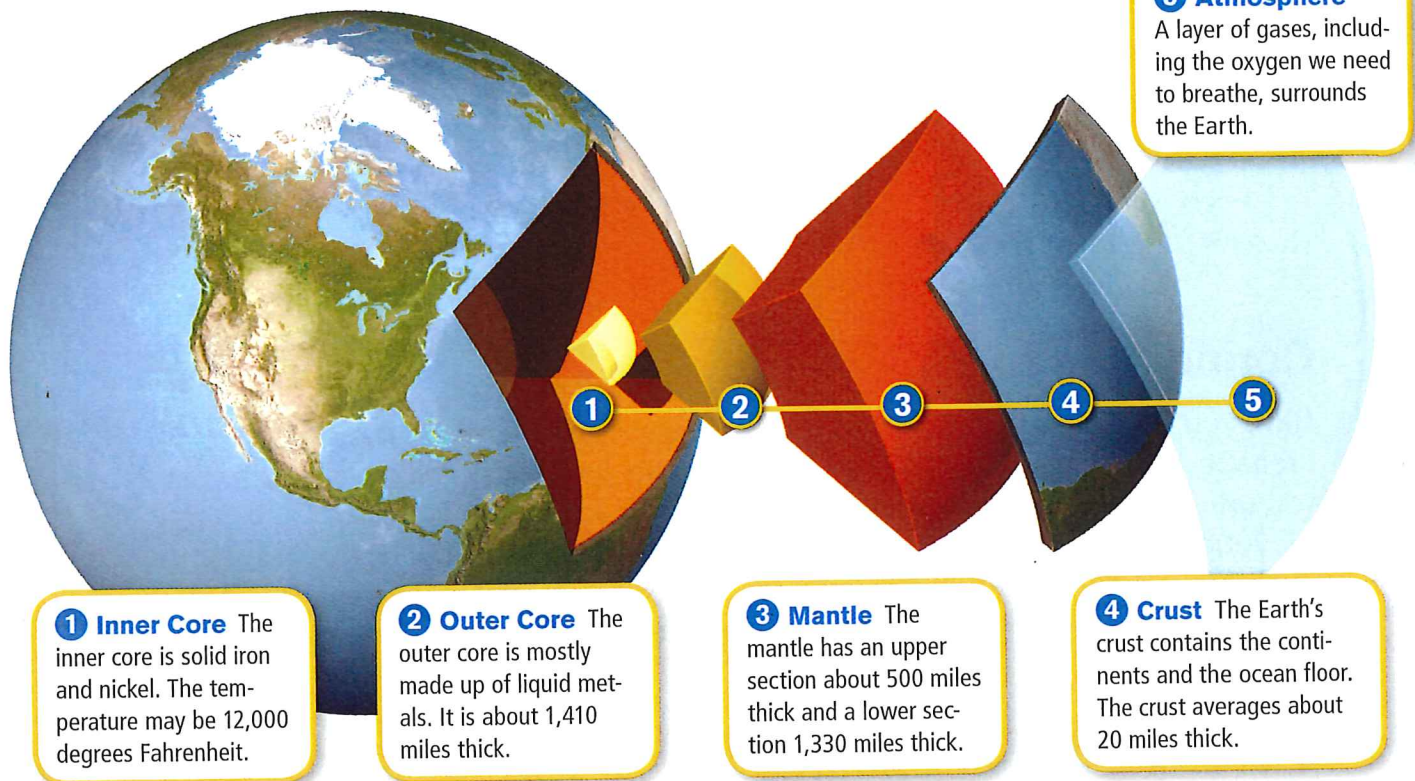
The Earth is one of eight planets that orbit the sun. It is located about 93 million miles from the sun. The Earth's circumference, or distance around, is 24,900 miles. Its diameter, or distance through the center of Earth, is about 7,900 miles. Earth is unique in the solar system—the sun and its planets—because it supports life. This is because the Earth has lots of breathable air and usable water. In fact, the Earth's surface is about three-fourths water and one-fourth land. The Earth appears to be a solid ball, but it is actually made of different layers that are like shells set inside each other.

San Francisco Earthquake The earthquake in 1989 was the worst quake since 1906.



Earth's Layers

It is about 3,900 miles to the center of the Earth. The Earth has five different layers.



Earth's Molten Interior The center of the Earth's interior is a hot metal core made up of one layer of iron and one of nickel. The inner core is solid. The outer core is liquid, because the metal has melted. Lying just above the core is the mantle. The mantle is a soft layer of hot rock, some of which is molten, or melted. It is the largest of the Earth's layers. The molten rock of the mantle is called **magma**.

The crust is the Earth's thin outer layer, or shell. It is the solid, rocky surface of the Earth that forms the ocean floors and the large landmasses called **continents**. The crust is the part of the Earth on which we live. It floats on top of the mantle. The crust is only about five miles thick under the oceans but averages about 22 miles thick under the continents. The Earth's layers are illustrated above.

Geographers have identified seven continents on the Earth's surface. The continents, in order of their size, are Asia, Africa, North America, South America, Antarctica, Europe, and Australia. Europe and Asia are actually one great landmass that is sometimes referred to as Eurasia or the Eurasian continent. Antarctica is a continent because it has a landmass beneath its icy surface. The Arctic does not, and so it is not a continent.

Tectonic Plates The surface of the Earth is constantly moving and changing, even as you read this sentence. Geographers use technological tools to observe and measure forces deep inside the Earth and on the surface that reshape the Earth's crust.

Plate movement, earthquakes, and the activity of volcanoes are all internal forces that change the landscape. The Earth's crust is divided into a number of large rigid pieces called **tectonic plates**. These plates are shown on the map at the beginning of the chapter. The continents and oceans are located on these plates, which float on the magma of the Earth's mantle. Heated magma cools as it reaches the crust and then sinks downward. This process causes the magma to act like a conveyor belt under the plates. The plates move slowly against each other, at a rate of up to four inches a year. The plate movement can cause earthquakes and volcanic eruptions. There are four types of tectonic plate movements that are shown in the diagrams below. Each of the movements causes changes in the shape of Earth's crust.

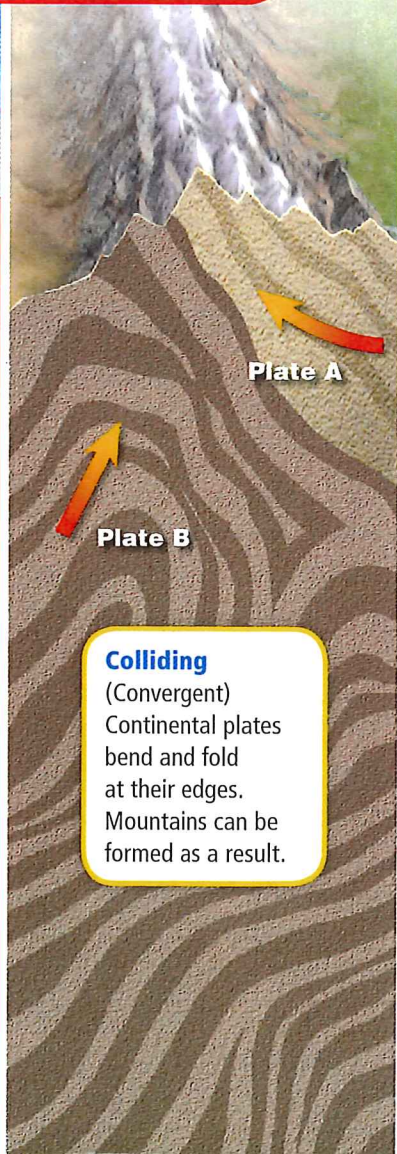
COMPARING Tectonic Plate Movements



Spreading
(Divergent) Magma pushes the plates apart. As rock cools, it sinks below the ocean surface.



Diving (Subduction)
Continental plate (lighter) forces oceanic (denser) plate under it. Volcanoes may result from this movement.




Colliding
(Convergent)
Continental plates bend and fold at their edges. Mountains can be formed as a result.



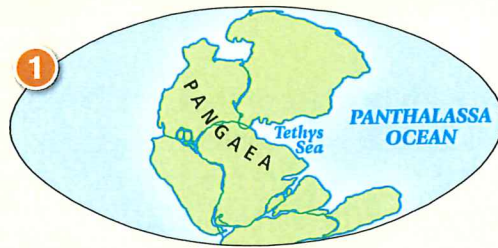
Sliding (Transform)
Plates slide past each other, causing a fracture in the crust. The fracture is called a fault. Some earthquakes are caused by sliding plates.

Continental Drift Theory

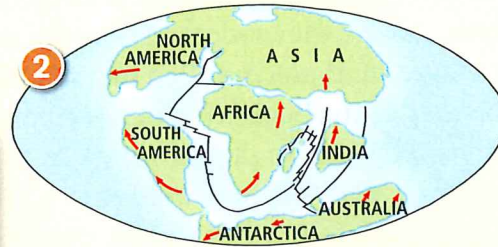
 [Click here](#) to see the movement of the continents @ [ClassZone.com](#)

CONNECT Geography & History

Draw Conclusions Which continents were connected 65 million years ago?




1 The world map at left shows the supercontinent of Pangaea about 200 million years ago as it begins to break apart.



2 This world map shows the Earth about 65 million years ago. Some of the modern-day continents are visible.

Continental Drift If you look at the continents, they look like giant pieces of a jigsaw puzzle waiting to be fit together. Alfred Wegener, a German meteorologist, noticed this pattern. He believed that the continents were once part of a supercontinent called Pangaea (pan•JEE•uh). He suggested that Pangaea divided and drifted apart about 200 million years ago. It contained almost all of the landmasses on Earth and was surrounded by one vast ocean. When it began to break apart, its pieces slowly moved in different directions, and some formed the continents we now know. To this day, the continents continue to move.

 **SUMMARIZE** Explain how internal forces shape the Earth's surface.

Extreme Events

 **KEY QUESTION** How are earthquakes and volcanoes connected?

Two events caused by internal forces may dramatically reshape the Earth's surface—earthquakes and volcanic eruptions. Both can be deadly, and both have powerful effects on human life.

Earthquakes An **earthquake** is a sudden movement of the Earth's crust that is followed by a series of shocks. Huge rocks along a line where faults are located slide apart and break up, causing that area of the Earth's surface to shake. The stress in the rocks builds for years. Then, energy is swiftly released outward through the ground in vibrations called shock waves.

Earthquakes occur constantly. Some we may not feel, but scientific instruments record them. Some produce slight shock waves. Other earthquakes and their aftershocks cause major disasters. Buildings collapse, cities are destroyed, and thousands of lives may be lost. Fires, floods, landslides, and avalanches can also follow earthquakes.

Earthquakes may also be triggered by the explosive action of a volcano. Most of Earth's active volcanoes are located in a zone around

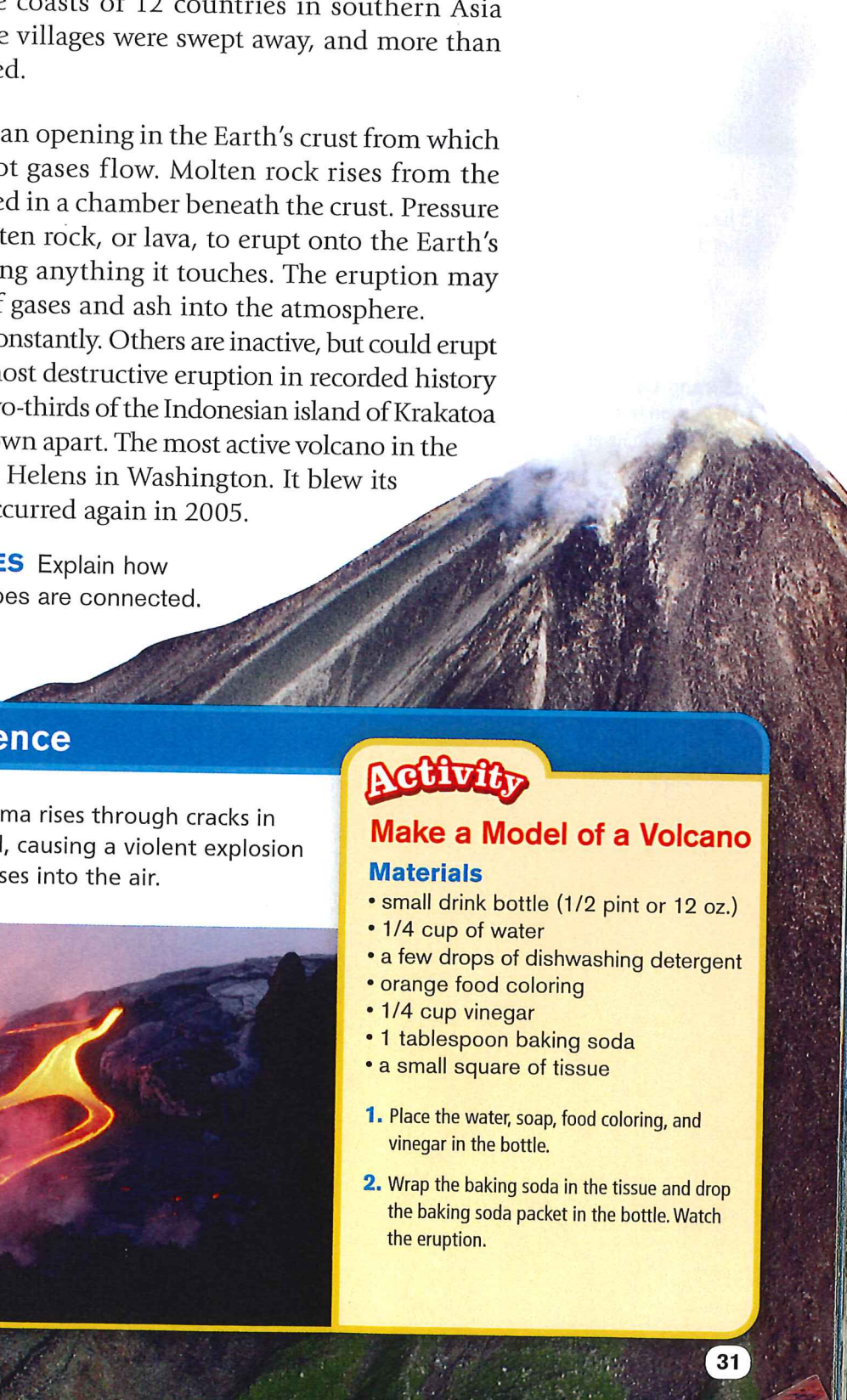
the rim of the Pacific Ocean called the **Ring of Fire**. A number of tectonic plates meet in this zone, and many of the largest earthquakes in the world have occurred there.

One of the biggest earthquakes ever recorded took place near the coast of Indonesia in 2004. It occurred on the floor of the Indian Ocean where two tectonic plates meet. The quake produced a giant ocean wave called a tsunami (tsu•NAH•mee). Within hours, the tsunami had devastated the coasts of 12 countries in southern Asia and eastern Africa. Whole villages were swept away, and more than 280,000 people were killed.

Volcanoes A **volcano** is an opening in the Earth's crust from which molten rock, ash, and hot gases flow. Molten rock rises from the Earth's mantle and is stored in a chamber beneath the crust. Pressure builds and forces the molten rock, or lava, to erupt onto the Earth's surface, burning or burying anything it touches. The eruption may also throw large clouds of gases and ash into the atmosphere.

Some volcanoes erupt constantly. Others are inactive, but could erupt at some future time. The most destructive eruption in recorded history happened in 1883, when two-thirds of the Indonesian island of Krakatoa (KRAK•uh•TOH•uh) was blown apart. The most active volcano in the United States is Mount St. Helens in Washington. It blew its top off in 1980. Activity occurred again in 2005.

 **UNDERSTAND CAUSES** Explain how earthquakes and volcanoes are connected.



CONNECT to Science

In a volcanic eruption, red-hot magma rises through cracks in the Earth's crust. Gases are released, causing a violent explosion of liquid rock, hot ash, and fiery gases into the air.

Kilauea, Hawaii

Activity

Make a Model of a Volcano

Materials

- small drink bottle (1/2 pint or 12 oz.)
- 1/4 cup of water
- a few drops of dishwashing detergent
- orange food coloring
- 1/4 cup vinegar
- 1 tablespoon baking soda
- a small square of tissue

1. Place the water, soap, food coloring, and vinegar in the bottle.
2. Wrap the baking soda in the tissue and drop the baking soda packet in the bottle. Watch the eruption.

External Forces Shaping the Earth

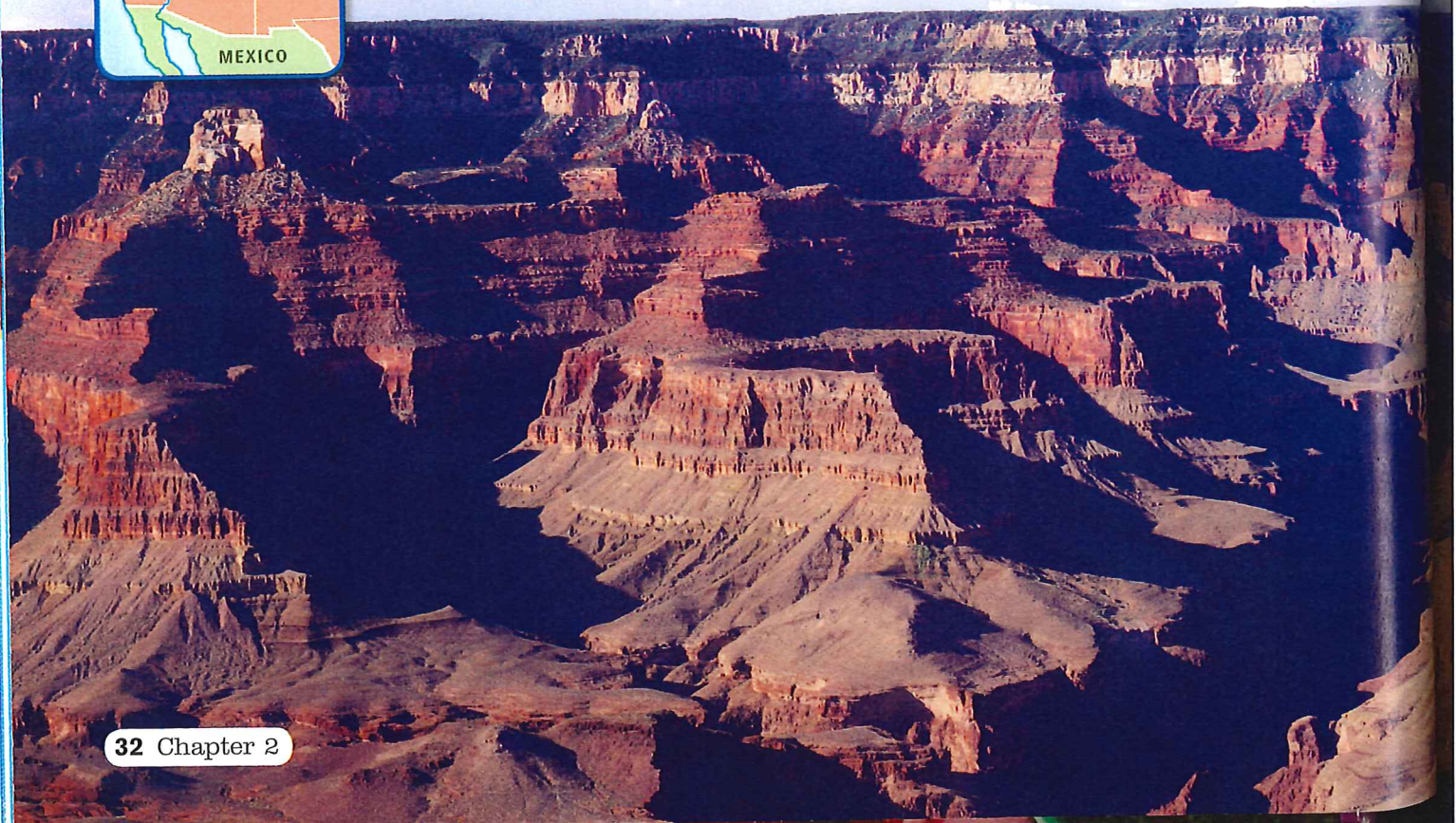
KEY QUESTION What external forces shape the Earth?

External forces also reshape the Earth's surface. The two main external forces are weathering and erosion. **Weathering** is the gradual physical and chemical breakdown of rocks near or on the Earth's surface. **Erosion** is the wearing away and movement of weathered materials from one place to another by the action of water, wind, or ice. As you can see, weathering and erosion work together to shape the Earth.

Weathering Weathering occurs slowly, over many years or even centuries. The two types of weathering are mechanical weathering and chemical weathering. Mechanical weathering is a process in which rocks are broken down into smaller pieces by physical means. It takes place when ice, extremes of hot and cold, or even tree roots cause rocks to split apart. It also occurs when hard objects, such as other rocks or sand, scrape or rub against a rock, and pieces of the rock break off.

Chemical weathering is caused by chemical reactions between the minerals in the rock and elements in the air or water. This process changes the make-up of the rock itself. For example, most rocks contain iron. When iron comes in contact with water, it rusts, which helps to break down the rock. Water and elements in the air can cause other minerals in rocks to dissolve.

The Grand Canyon The Grand Canyon is located on the Colorado River in Arizona. It is an example of both weathering and erosion caused by wind and water.



Erosion New landforms and new soil are formed by erosion. It occurs when materials loosened by weathering are moved by water, wind, or ice to new locations. Currents in streams and rivers pick up loose materials and deposit them downstream or carry them out to sea. These tiny pieces of rock, deposited by water, wind, or ice are called **sediment**. Sediment can be sand, stone, or finely ground particles called silt.

Wave action along coastlines carries rocks and sand from one place to another. Waves also pound boulders into smaller rocks. Wind erosion lifts particles from the Earth's surface and blows them great distances. The wind's actions can reshape rock surfaces. Arizona's Grand Canyon is a result of both wind and water erosion.

Another type of erosion is caused by glaciers. **Glaciers** are large, slow-moving masses of ice. They grind rocks and boulders underneath the ice and leave behind the rock when the ice melts. Parts of the central United States have been shaped by glacial erosion.



Beach Erosion Ocean waves and tides eroded this section of beach in California.

SYNTHESIZE Explain how external forces shape the Earth's surface.

Section 1 Assessment

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TERMS & NAMES

1. Explain the importance of

- continent
- tectonic plate
- weathering
- erosion

USE YOUR READING NOTES

2. Categorize Use your completed chart to answer the following question:

Are external or internal forces responsible for volcanoes? Explain your answer.

INTERNAL FORCES	EXTERNAL FORCES
1.	1.
2.	2.
3.	3.
4.	4.

KEY IDEAS

3. What are the five layers that make up the Earth's interior and exterior?
4. How were the continents formed?
5. What are the two major external forces reshaping the Earth?

CRITICAL THINKING

6. **Draw Conclusions** How does the movement of wind, water, or ice reshape the Earth's surface?
7. **Analyze Causes and Effects** What is the relationship between plate movement, volcanoes, and earthquakes?
8. **CONNECT to Today** In which parts of the United States are external forces shaping the landscape?
9. **ART Create a Puzzle** Make a copy of a map of the world. Cut out the continents. Use the continents as puzzle pieces to form the continent of Pangaea. When you have finished putting the pieces together, draw an outline around the entire supercontinent.