

# The Land

## SECTION 3

### If YOU lived there...

You live in the state of Washington. All your life, you have looked out at the beautiful, cone-shaped peaks of nearby mountains. One of them is Mount Saint Helens, an active volcano. You know that in 1980 it erupted violently, blowing a hole in the mountain and throwing ash and rock into the sky. Since then, scientists have watched the mountain carefully.

### How do you feel about living near a volcano?

**BUILDING BACKGROUND** Over billions of years, many different forces have changed Earth's surface. Processes deep underground have built up landforms and even shifted the position of continents. Wind, water, and ice have also shaped the planet's landforms. Changes in Earth's surface continue to take place.

## Landforms

Do you know the difference between a valley and a volcano? Can you tell a peninsula from a plateau? If you answered yes, then you are familiar with some of Earth's many landforms. **Landforms** are shapes on the planet's surface, such as hills or mountains. Landforms make up the landscapes that surround us, whether it's the rugged mountains of central Colorado or the flat plains of Oklahoma.

Earth's surface is covered with landforms of many different shapes and sizes. Some important landforms include:

- mountains, land that rises higher than 2,000 feet (610 m)
- valleys, areas of low land located between mountains or hills
- plains, stretches of mostly flat land
- islands, areas of land completely surrounded by water
- peninsulas, land surrounded by water on three sides

Because landforms play an important role in geography, many scientists study how landforms are made and how they affect human activity.

**READING CHECK** Summarizing What are some common landforms?

### What You Will Learn...

#### Main Ideas

1. Earth's surface is covered by many different landforms.
2. Forces below Earth's surface build up our landforms.
3. Forces on the planet's surface shape Earth's landforms.
4. Landforms influence people's lives and culture.

#### The Big Idea

Processes below and on Earth's surface shape the planet's physical features.

### Key Terms

landforms, p. 35  
continents, p. 36  
plate tectonics, p. 36  
lava, p. 37  
earthquakes, p. 38  
weathering, p. 39  
erosion, p. 39

### TAKING NOTES

As you read, use a diagram like the one below to take notes on Earth's landforms. In the circles, be sure to note how landforms are created, change, and affect people's lives.



## Forces below Earth's Surface

Geographers often study how landforms are made. One explanation for how landforms have been shaped involves forces below Earth's surface.

### Earth's Plates

To understand how these forces work, we must examine Earth's **structure**. The planet is made up of three layers. A solid inner core is surrounded by a liquid layer, or mantle. The solid outer layer of Earth is called the crust. The planet's **continents, or large landmasses**, are part of Earth's crust.

Geographers use the theory of plate tectonics to explain how forces below Earth's surface have shaped our landforms. The theory of **plate tectonics** suggests that Earth's surface is divided into a dozen or so slow-moving plates, or pieces of Earth's crust. As you can see in the image below,

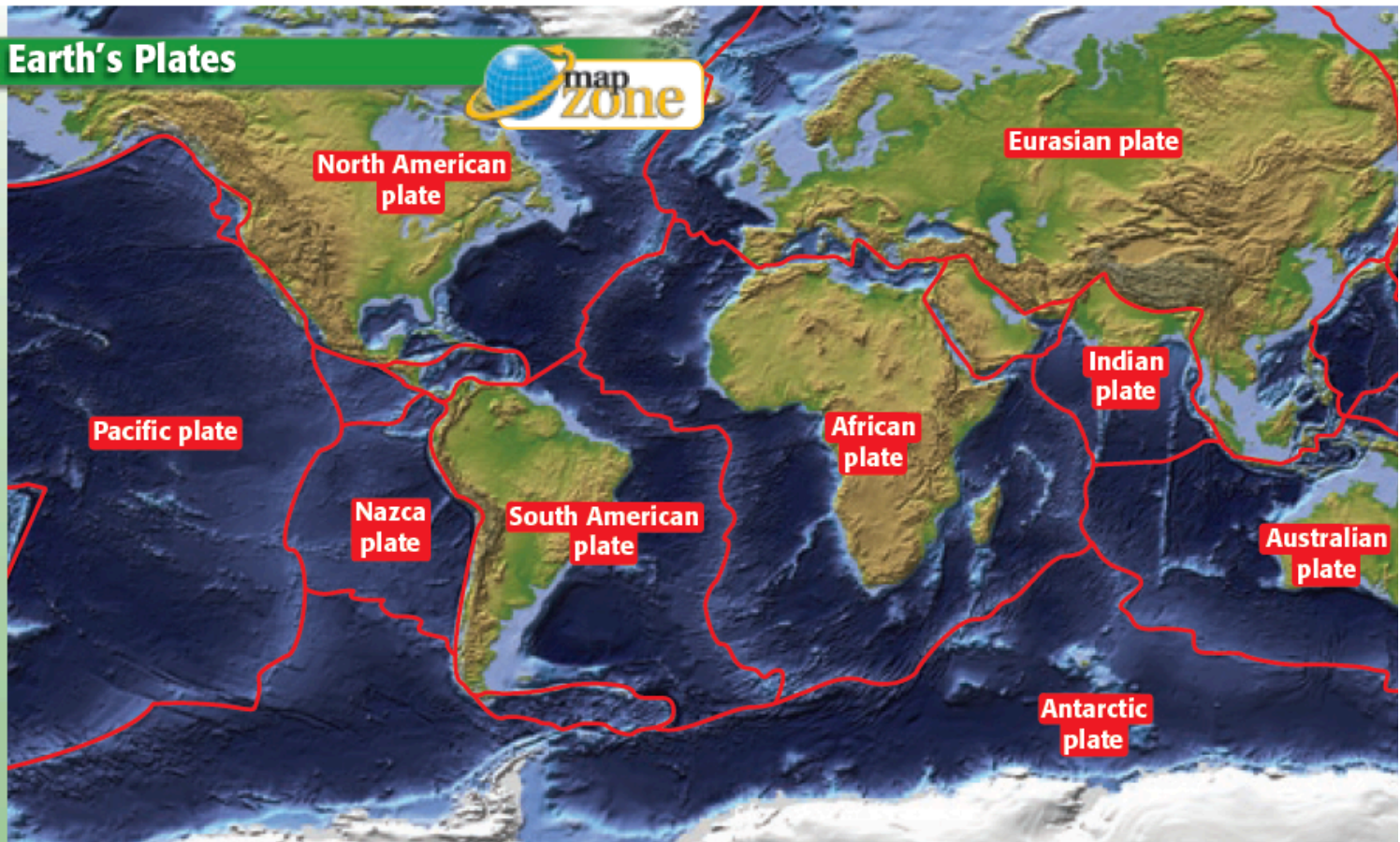
some plates, like the Pacific plate, are quite large. Others, like the Nazca plate, are much smaller. These plates cover Earth's entire surface. Some plates are under the ocean. These are known as ocean plates. Other plates, known as continental plates, are under Earth's continents.

Why do these plates move? Energy deep inside the planet puts pressure on Earth's crust. As this pressure builds up, it forces the plates to shift. Earth's tectonic plates all move. However, they move in different directions and at different speeds.

### The Movement of Continents

Earth's tectonic plates move slowly—up to several inches per year. The continents, which are part of Earth's plates, shift as the plates move. If we could look back some 200 million years, we would see that the continents have traveled great distances. This idea is known as continental drift.

## Earth's Plates



### ACADEMIC VOCABULARY

**structure** the way something is set up or organized



The theory of continental drift, first developed by Alfred Wegener, states that the continents were once united in a single supercontinent. According to this theory, Earth's plates shifted over millions of years. As a result, the continents slowly separated and moved to their present positions.

Earth's continents are still moving. Some plates move toward each other and collide. Other plates separate and move apart. Still others slide past one another. Over time, colliding, separating, and sliding plates have shaped Earth's landforms.

### Plates Collide

As plates collide, the energy created from their collision produces distinct landforms. The collision of different types of plates creates different shapes on Earth's surface. Ocean trenches and mountain ranges are two examples of landforms produced by the collision of tectonic plates.



#### BIOGRAPHY

##### Alfred Wegener (1880–1930)

German scientist Alfred Wegener's fascination with the similarities between the western coast of Africa and the eastern coast of South America led to his theory of continental drift. Wegener argued that the two continents had once been joined together. Years of plate movement broke the continents apart and moved them to their current locations. It was only after Wegener's death that his ideas became a central part of the theory of plate tectonics.

The theory of plate tectonics suggests that the plates that make up Earth's crust are moving, usually only a few inches per year. As Earth's plates collide, separate, and slide past each other, they create forces great enough to shape many of Earth's landforms.

**ANALYZING VISUALS** Looking at the map, what evidence indicates that plates have collided or separated?

When two ocean plates collide, one plate pushes under the other. This process creates ocean trenches. Ocean trenches are deep valleys in the ocean floor. Near Japan, for example, the Pacific plate is slowly moving under other plates. This collision has created several deep ocean trenches, including the world's deepest trench, the Mariana Trench.

Ocean plates and continental plates can also collide. When this occurs, the ocean plate drops beneath the continental plate. This action forces the land above to crumple and form a mountain range. The Andes in South America, for example, were formed when the South American and Nazca plates collided.

The collision of two continental plates also results in mountain-building. When continental plates collide, the land pushes up, sometimes to great heights. The world's highest mountain range, the Himalayas, formed when the Indian plate crashed into the Eurasian plate. In fact, the Himalayas are still growing as the two plates continue to crash into each other.

### Plates Separate

A second type of plate movement causes plates to separate. As plates move apart, gaps between the plates allow magma, a liquid rock from the planet's interior, to rise to Earth's crust. **Lava, or magma that reaches Earth's surface,** emerges from the gap that has formed. As the lava cools, it builds a mid-ocean ridge, or underwater mountain. For example, the separation of the North American and Eurasian plates formed the largest underwater mountain, the Mid-Atlantic Ridge. If these mid-ocean ridges grow high enough, they can rise above the surface of the ocean, forming volcanic islands. Iceland, on the boundary of the Eurasian and North American plates, is an example of such an island.

#### FOCUS ON READING

The suffix *-sion* means the act of. What does the word *collision* mean?

## Plates Slide

Tectonic plates also slide past each other. As plates pass by one another, they sometimes grind together. This grinding produces **earthquakes**—sudden, violent movements of Earth's crust. Earthquakes often take place along faults, or breaks in Earth's crust where movement occurs. In California, for

example, the Pacific plate is sliding by the edge of the North American plate. This has created the San Andreas Fault zone, an area where earthquakes are quite common.

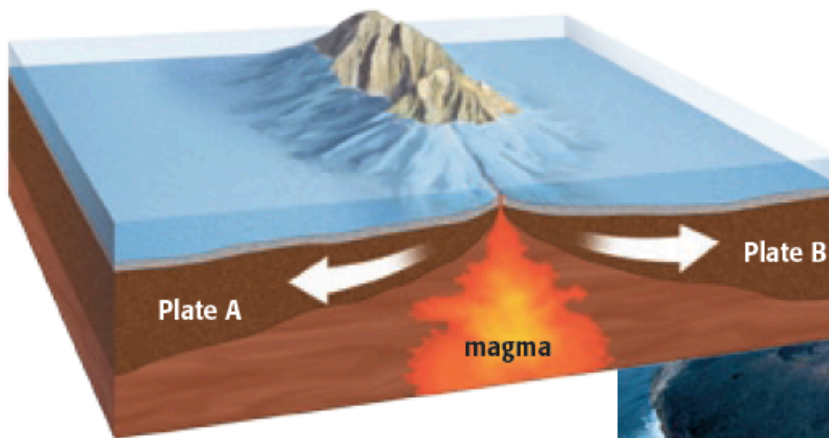
The San Andreas Fault zone is one of many areas that lie along the boundaries of the Pacific plate. The frequent movement of this plate produces many earthquakes and volcanic eruptions along its edges. In fact, the region around the Pacific plate, called the Ring of Fire, is home to most of the world's earthquakes and volcanoes.

## Plate Movement

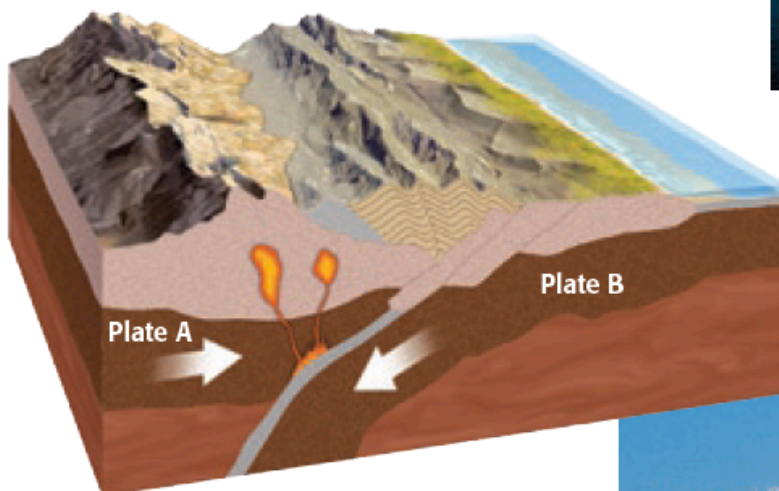
The movement of tectonic plates has produced many of Earth's landforms. Volcanoes, islands, and mountains often result from the separation or collision of Earth's plates.

**ANALYZING VISUALS** What type of landform is created by the collision of two continental plates?

**READING CHECK** Finding Main Ideas What forces below Earth's surface shape landforms?



The separation of plates can allow magma to rise up and create volcanic islands like Surtsey Island, near Iceland.



The Himalayas in South Asia resulted from the collision of two massive continental plates.





## Forces on Earth's Surface

For millions of years, the movement of Earth's tectonic plates has been building up landforms on Earth's surface. At the same time, other forces are working to change those very same landforms.

Imagine a small pile of dirt and rock on a table. If you poured water on the pile, it would move the dirt and rock from one place to another. Likewise, if you were to blow at the pile, the rock and dirt would also move. The same process happens in nature. Weather, water, and other forces change Earth's landforms by wearing them away or reshaping them.

### Weathering

One force that wears away landforms is weathering. **Weathering is the process by which rock is broken down into smaller pieces.** Several factors cause rock to break down. In desert areas, daytime heating and nighttime cooling can cause rocks to crack. Water may get into cracks in rocks and freeze. The ice then expands with a force great enough to break the rock. Even the roots of trees can pry rocks apart.

Regardless of which weathering process is at work, rocks eventually break down. These small pieces of rock are known as sediment. Once weathering has taken place, wind, ice, and water often move sediment from one place to another.

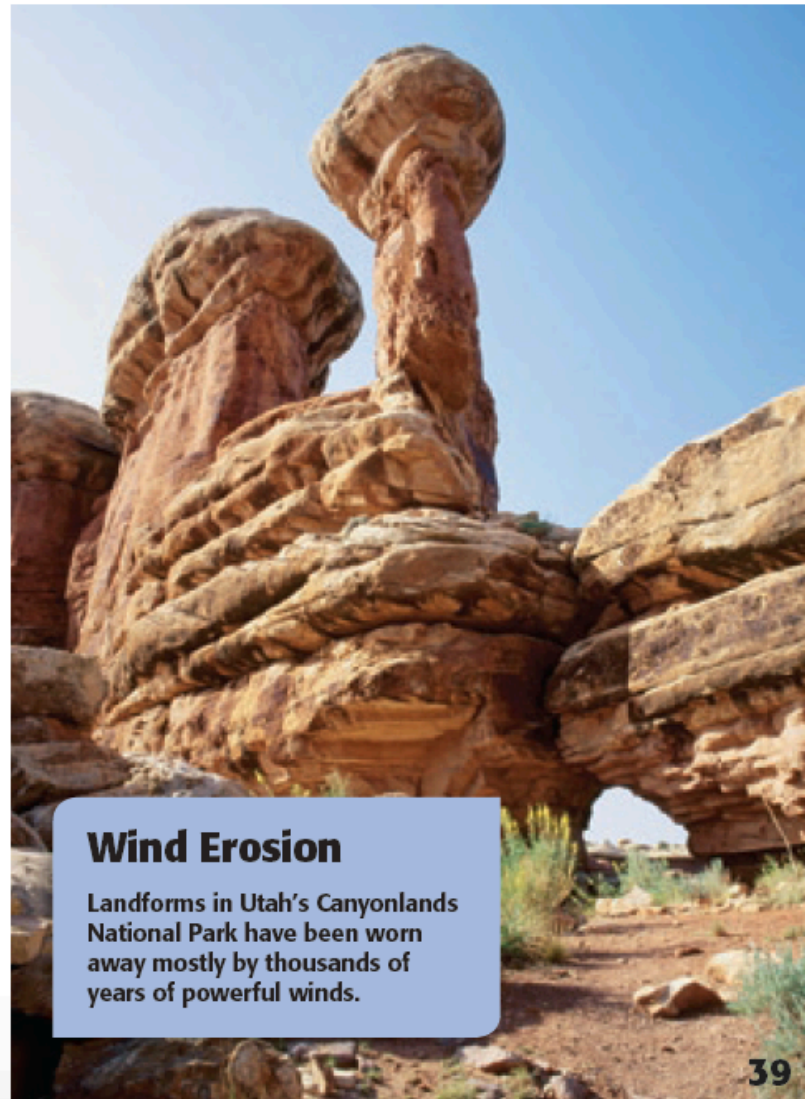
### Erosion

Another force that changes landforms is the process of erosion. **Erosion is the movement of sediment from one location to another.** Erosion can wear away or build up landforms. Wind, ice, and water all cause erosion.

Powerful winds often cause erosion. Winds lift sediment into the air and carry it across great distances. On beaches and in

deserts, wind can deposit large amounts of sand to form dunes. Blowing sand can also wear down rock. The sand acts like sandpaper to polish and wear away at rocks. As you can see in the photo below, wind can have a dramatic effect on landforms.

Earth's glaciers also have the power to cause massive erosion. Glaciers, or large, slow-moving sheets of ice, build up when winter snows do not melt the following summer. Glaciers can be huge. Glaciers in Greenland and Antarctica, for example, are great sheets of ice up to two miles (3 km) thick. Some glaciers flow slowly downhill like rivers of ice. As they do so, they erode the land by carving large U-shaped valleys and sharp mountain peaks. As the ice flows downhill, it crushes rock into sediment and can move huge rocks long distances.



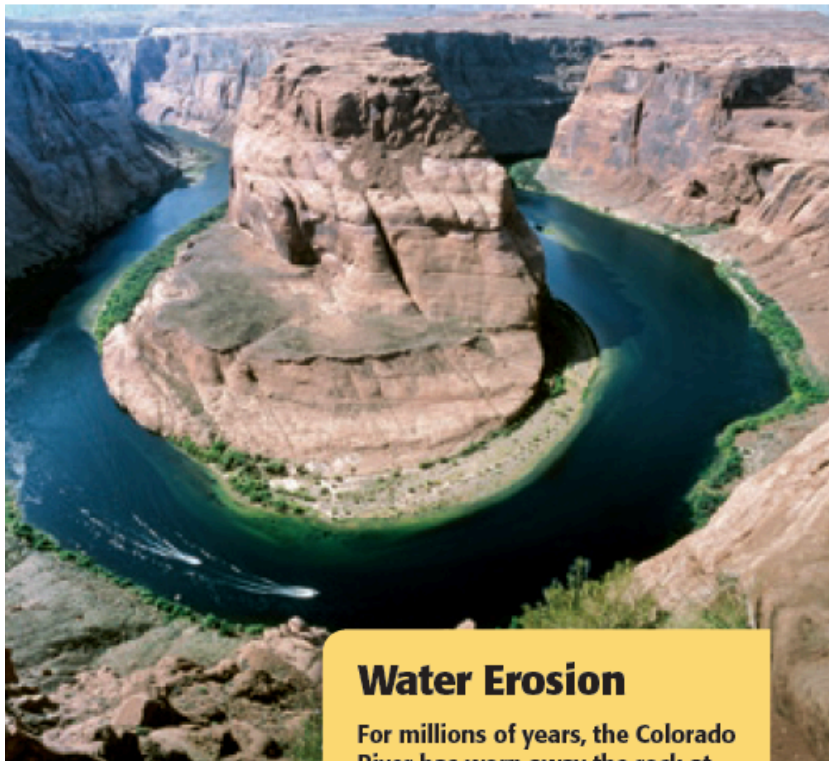
### Wind Erosion

Landforms in Utah's Canyonlands National Park have been worn away mostly by thousands of years of powerful winds.

Water is the most common cause of erosion. Waves in oceans and lakes can wear away the shore, creating jagged coastlines, like those on the coast of Oregon. Rivers also cause erosion. Over many years, the flowing water can cut through rock forming canyons, or narrow areas with steep walls. Arizona's Horseshoe Bend and Grand Canyon are examples of canyons created in this way.

Flowing water shapes other landforms as well. When water deposits sediment in new locations, it creates new landforms. For example, rivers create floodplains when they flood their banks and deposit sediment along the banks. Sediment that is carried by a river all the way out to sea creates a delta. The sediment settles to the bottom, where the river meets the sea. The Nile and Mississippi rivers have created two of the world's largest river deltas.

**READING CHECK** **Comparing** How are weathering and erosion similar?



### **Water Erosion**

For millions of years, the Colorado River has worn away the rock at Horseshoe Bend in Arizona.

## **Landforms Influence Life**

Why do you live where you do? Perhaps your family moved to the desert to avoid harsh winter weather. Or possibly one of your ancestors settled near a river delta because its fertile soil was ideal for growing crops. Maybe your family wanted to live near the ocean to start a fishing business. As these examples show, landforms exert a strong influence on people's lives. Earth's landforms affect our settlements and our culture. At the same time, we affect the landforms around us.

Earth's landforms can influence where people settle. People sometimes settle near certain landforms and avoid others. For example, many settlements are built near fertile river valleys or deltas. The earliest urban civilization, for example, was built in the valley between the Tigris and Euphrates rivers. Other times, landforms discourage people from settling in a certain place. Tall, rugged mountains, like the Himalayas, and harsh desert climates, like the Sahara, do not usually attract large settlements.

Landforms affect our culture in ways that we may not have noticed. Landforms often influence what jobs are available in a region. For example, rich mineral deposits in the mountains of Colorado led to the development of a mining industry there. Landforms even affect language. On the island of New Guinea in Southeast Asia, rugged mountains have kept the people so isolated that more than 700 languages are spoken on the island today.

People sometimes change landforms to suit their needs. People may choose to modify landforms in order to improve their lives. For example, engineers built the Panama Canal to make travel from the Atlantic Ocean to the Pacific Ocean easier. In Southeast Asia, people who farm on steep hillsides cut terraces into the slope to





## Living with Landforms

The people of Rio de Janeiro, Brazil, have learned to adapt to the mountains and bays that dominate their landscape.

**ANALYZING VISUALS** How have people in Rio de Janeiro adapted to their landscape?

create more level space to grow their crops. People have even built huge dams along rivers to divert water for use in nearby towns or farms.

**READING CHECK** **Analyzing** What are some examples of humans adjusting to and changing landforms?

**SUMMARY AND PREVIEW** Landforms are created by actions deep within the planet's surface, and they are changed by forces on Earth's surface, like weathering and erosion. In the next chapter you will learn how other forces, like weather and climate, affect Earth's people.

## Section 3 Assessment

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Online Quiz

KEYWORD: SK7 HP2

### Reviewing Ideas, Terms, and Places

- Describe** What are some common **landforms**?
  - Analyze** Why do geographers study landforms?
- Identify** What is the theory of **plate tectonics**?
  - Compare and Contrast** How are the effects of colliding plates and separating plates similar and different?
  - Predict** How might Earth's surface change as tectonic plates continue to move?
- Recall** What is the process of **weathering**?
  - Elaborate** How does water affect sediment?
- Recall** How do landforms affect life on Earth?
  - Predict** How might people adapt to life in an area with steep mountains?

### Critical Thinking

- Analyzing** Use your notes and the chart below to identify the different factors that alter Earth's landforms and the changes that they produce.

Factor	Change in Landform

### FOCUS ON WRITING

- Writing about Earth's Land** Think of some vivid words you could use to describe Earth's landforms. As you think of them, add them to your notebook.