

CHAPTER

2

The Earth



GeoJournal

As you read this chapter, use your journal to note facts about our planet. Include descriptive details about Earth's physical features, its structure, and the forces of change that shape its surface.



Chapter Overview Visit the **Glencoe World Geography** Web site at tx.geography.glencoe.com and click on Chapter Overviews—Chapter 2 to preview information about Planet Earth.

CLICK HERE

CONTENTS

Guide to Reading

Consider What You Know

What do you know about Planet Earth? How does it compare to other planets and to other objects, such as stars and moons? How would you describe the surface of the earth?

Read to Find Out

- Where is Earth located in our solar system?
- How is Earth shaped?
- What is Earth's structure?
- What types of landforms are found on Earth?

Terms to Know

- hydrosphere
- lithosphere
- atmosphere
- biosphere
- continental shelf

Places to Locate

- Australia
- Antarctica
- Europe
- Asia
- North America
- South America
- Africa
- Mount Everest
- Dead Sea
- Mariana Trench

◀ Earth viewed from space

Planet Earth

NATIONAL GEOGRAPHIC

A Geographic View

Patterns of Life

As we fly over the Sahara, we all strain to see Lake Chad, which is between the northern deserts and the green portion of equatorial Africa. Its level is a good indicator of how wet or dry this boundary region, called the Sahel, has been. It was mostly cloudy during my first flight: a good sign for those living below. On my second flight, 17 months later, we could see that the level had risen: The drought in the Sahel had abated [ended] for the moment.

—Jay Apt, "Orbit: The Astronauts' View of Home,"
National Geographic, November 1996

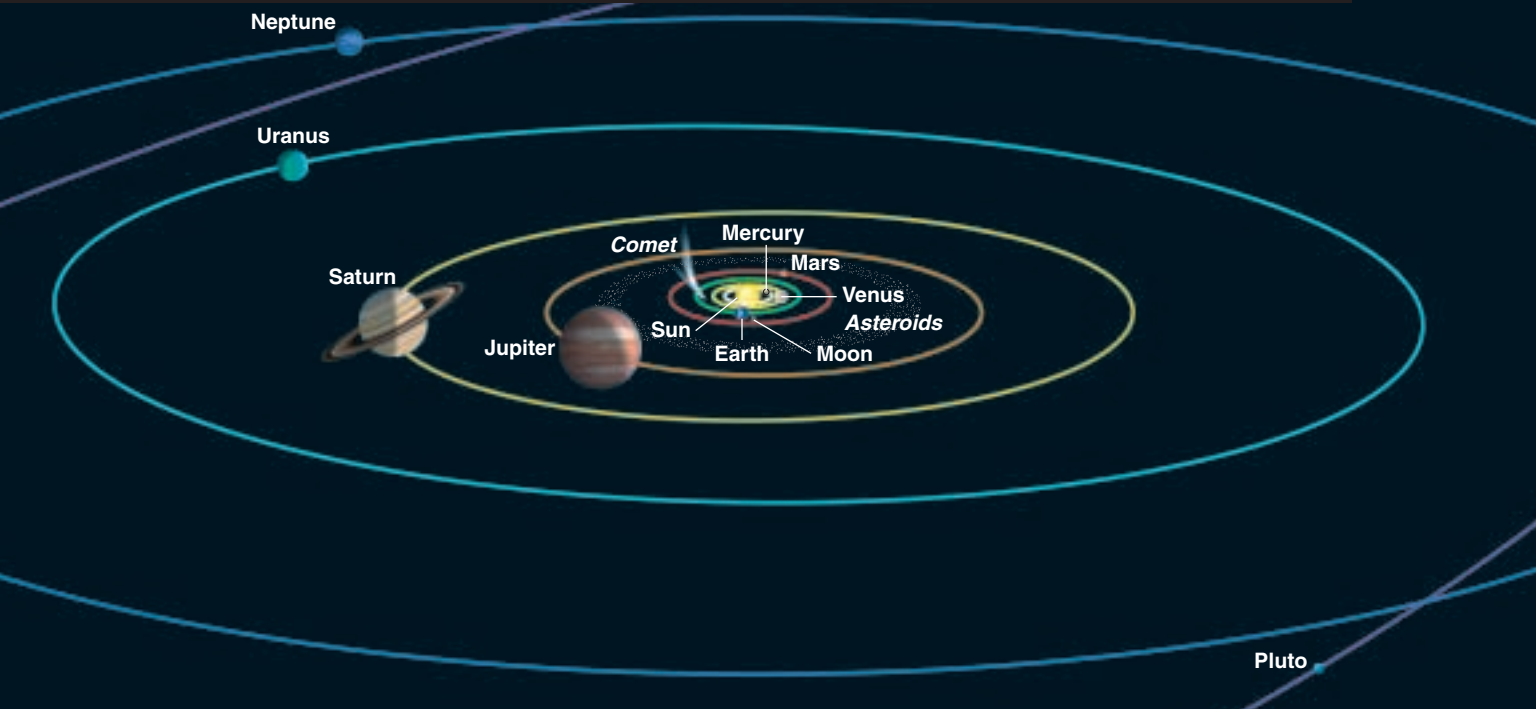


An astronaut, seeing Earth from the blackness of space, described it as "piercingly beautiful." From the vantage point of space, the earth's great beauty resembles a blue and white marble, with contrasts of water and land beneath huge swirls of white clouds. Together these features form the physical environment of the earth. In this section you will discover what humans know about the physical nature of our planet, Earth.

Our Solar System

Earth is part of our solar system, which is made up of the sun and all of the countless objects that revolve around it. At our solar system's center is the sun—a star, or ball of burning gases. About 109 times wider than Earth, the sun's enormous mass—the amount of matter it contains—creates a strong pull of gravity. This basic physical force keeps the earth and the other objects revolving around the sun.

The Solar System



Geography Skills for Life

- 1. Interpreting Diagrams** Which four planets are closest to the sun?
- 2. Applying Geography Skills** What characteristics do the inner planets share? What characteristics do the outer planets share?

The Planets: Neighbors in Space

Except for the sun, spheres called planets are the largest objects in our solar system. At least nine planets exist, and each is in its own orbit around the sun. The diagram above shows that the planets vary in distance from the sun. Mercury, Venus, Earth, and Mars are the inner planets, or those nearest the sun. Earth, the third planet from the sun, is about 93 million miles (about 150 million km) away. Farthest from the sun are the outer planets—Jupiter, Saturn, Uranus, Neptune, and Pluto.

The planets vary in size. Jupiter is the largest. Earth ranks fifth in size among the planets, and distant Pluto is the smallest. All of the planets except Mercury and Venus have moons, smaller spheres or satellites that orbit them. The number of

moons each planet has also differs. Earth has 1 moon, and Saturn has at least 18 moons.

All of the planets except Pluto are grouped into two types—terrestrial planets and gas giant planets. Mercury, Venus, Earth, and Mars are called *terrestrial planets* because they have solid, rocky crusts. Mercury and Venus are scalding hot, and Mars is a cold, barren desert. Only Earth has liquid water at the surface and can support varieties of life.

Farther from the sun are the *gas giant planets*—Jupiter, Saturn, Uranus, and Neptune. They are much more gaseous and less dense than the terrestrial planets, even though they are larger in diameter. Each gas giant planet is itself like a miniature solar system, with orbiting moons and thin, encircling rings. Only

Saturn’s rings, however, are easily seen from Earth by telescope. Pluto, the exception among the planets, is a ball of ice and rock.

Asteroids, Comets, and Meteoroids

In addition to the planets, thousands of smaller objects, including asteroids, comets, and meteoroids, revolve around the sun. Asteroids are small, irregularly shaped, planetlike objects. They are found mainly between the orbits of Mars and Jupiter in a region called the *asteroid belt*. A few asteroids follow paths that cross the earth’s orbit.

Comets, made of icy dust particles and frozen gases, look like bright balls with long, feathery tails. Their orbits are inclined at every possible angle to the earth’s orbit. They may approach from any direction.

Meteoroids are pieces of space debris—chunks of rock and iron. When they occasionally enter Earth’s gravitational field, friction usually burns them up before they reach the earth’s surface. Those that collide with Earth are called meteorites. Meteorite strikes, though rare, can significantly affect the landscape, leaving craters and causing other devastation. In 1908 a huge area of forest in the remote Russian region of Siberia was flattened and burned by a “mysterious fireball.” Scientists theorize it was a meteorite or comet. As a writer describes the effects:

“The heat incinerated herds of reindeer and charred tens of thousands of evergreens across hundreds of square miles. For days, and for thousands of miles around, the sky remained bright with an eerie orange glow—as far away as western Europe people were able to read newspapers at night without a lamp.”

Richard Stone, “The Last Great Impact on Earth,” *Discover*, September 1996

Getting to Know Earth

Although globes show our planet as a perfect sphere, the earth is really a rounded object wider around the center than from top to bottom. Earth has a larger diameter at the Equator—about 7,930 miles (12,760 km)—than from Pole to Pole, but the

difference is less than 1 percent. With a circumference of about 24,900 miles (40,070 km), Earth is the largest of the inner planets.

Water, Land, and Air

The surface of the earth is made up of water and land. About 70 percent of our planet’s surface is water, which gives the planet the deep blue appearance that astronauts see from space. Oceans, lakes, rivers, and other bodies of water make up a part of the earth called the **hydrosphere**.

About 30 percent of the earth’s surface is land, including continents and islands. Land makes up a part of the earth called the **lithosphere**, the earth’s crust. The lithosphere also includes the ocean basins, or the land beneath the oceans.

The air we breathe is part of Earth’s **atmosphere**, a layer of gases extending about 6,000 miles (9,700 km) above the planet’s surface. The atmosphere is composed of 78 percent nitrogen, 21 percent oxygen, and small amounts of argon and other gases.

All people, animals, and plants live on the earth’s surface, close to the earth’s surface, or in the atmosphere. The part of the earth that supports life is the **biosphere**. Life outside the biosphere, such as on a space station orbiting Earth, exists only with the assistance of mechanical life-support systems.

Landforms

Landforms are the natural features of the earth’s surface. The diagram on pages 14–15 shows many of the earth’s landforms, made up of physical features with a particular shape or elevation. Four major landforms are mountains, hills, plateaus, and plains. Others include valleys, canyons, and basins. Landforms often contain rivers, lakes, and streams.

Underwater landforms are as diverse as those found on dry land. In some places the ocean floor is a flat plain. Other parts of the seabed feature mountain ranges, cliffs, valleys, and deep trenches.

Seen from space, Earth’s most visible landforms, however, are the seven large landmasses called continents. Two continents, **Australia** and **Antarctica**, stand alone, while the others are joined in some way. **Europe** and **Asia** are actually parts of one huge landmass called Eurasia. A narrow neck of land called the Isthmus of Panama links **North America** and **South America**. At the Sinai



Geography

Skills for Life

Planet Earth Parts of the atmosphere (left), lithosphere (center), and hydrosphere (right) form the biosphere, the part of the Earth where life exists.

Human-Environment Interaction How does human activity impact the biosphere?

Peninsula, the human-made Suez Canal separates Africa and Asia.

The part of a continent that extends underwater is called a **continental shelf**. Continental shelves are narrow in some places and wide in others. They slope out from land for as much as 800 miles (1,287 km) and descend gradually to a depth of about 660 feet (200 m) where a sharp drop marks the beginning of the continental slope. This area drops more sharply to the ocean floor.

Earth's Heights and Depths

Great contrasts exist in the heights and depths of the earth's surface. The highest point on Earth is in South Asia at the top of **Mount Everest**, which is

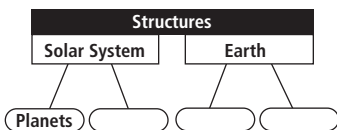
29,035 feet (8,852 m) above sea level. The lowest dry land point, at 1,349 feet (411 m) below sea level, is the shore of the **Dead Sea** in Southwest Asia. Earth's deepest known depression lies under the Pacific Ocean southwest of Guam in the **Mariana Trench**, a long, narrow, underwater canyon about 35,827 feet (10,923 m) deep. These and other natural features have developed as the earth has changed over millions of years. In the next section you will learn about the forces of change that have shaped the earth.

TAKS Practice

SECTION 1 ASSESSMENT

Checking for Understanding

- 1. Define** hydrosphere, lithosphere, atmosphere, biosphere, continental shelf.
- 2. Main Ideas** Copy the diagram below on your paper, filling in information about the structures of the solar system and the earth.



Critical Thinking

- 3. Drawing Conclusions** Recently NASA has launched space probes to explore Mars. Why might Mars have been chosen for these explorations?
- 4. Making Inferences** Think about Earth's surface and list conditions that must be present in a space station in order to support life.
- 5. Comparing and Contrasting** How do the inner planets differ from the outer planets?

Analyzing Diagrams

- 6. Location** Study the diagram of the solar system on page 34. How is the size of a planet's orbit influenced by its distance from the sun?

Applying Geography

- 7. A Delicate Balance** Think about the ratio of water and land on Earth. Write a description of how Earth's physical features would be different if the proportions were reversed.

Guide to Reading

Consider What You Know

Through observation you are familiar with some features of the earth's surface. These features have been shaped by forces above and beneath the earth's surface. How many of these forces can you name?

Read to Find Out

- How do Earth's layers contribute to the planet's physical characteristics?
- What internal forces operate to affect Earth's surface, the setting for human life?
- What external forces affect Earth's surface?

Terms to Know

- mantle
- continental drift
- magma
- plate tectonics
- subduction
- accretion
- spreading
- fold
- fault
- weathering
- erosion
- loess
- glacier
- moraine

Places to Locate

- San Andreas Fault
- Ring of Fire

Forces of Change

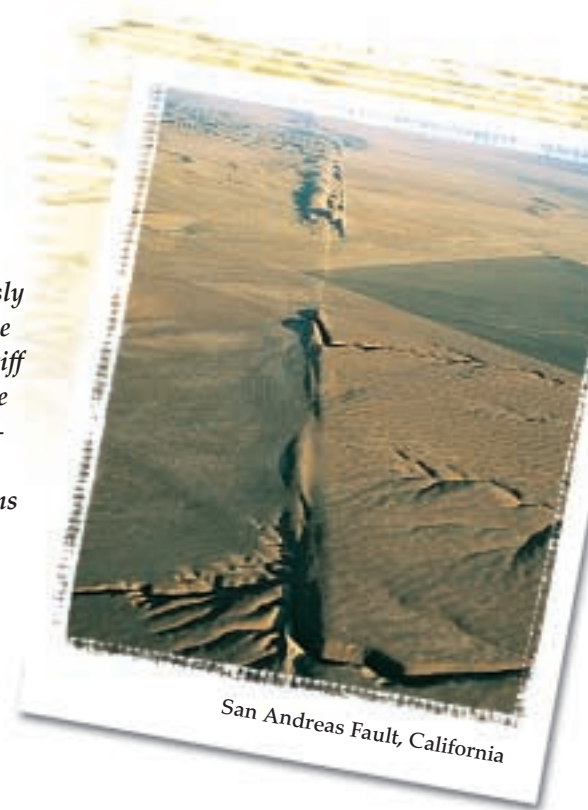
 NATIONAL GEOGRAPHIC

A Geographic View

A Planet in Motion

Scientists now know that the earth is dynamic and enormously complex. At the [earth's] surface ride more than a dozen huge, stiff fragments, or plates. They move at a slower-than-snail's pace—only inches a year—but cover thousands of miles over millions of years. As they collide and separate, they change the face of the globe by deforming and rearranging its features. The engine that propels [these] plates lies below: hot inner layers that churn like thick soup simmering in very slow motion.

—Keay Davidson and A.R. Williams, "Under Our Skin: Hot Theories on the Center of the Earth," National Geographic, January 1996

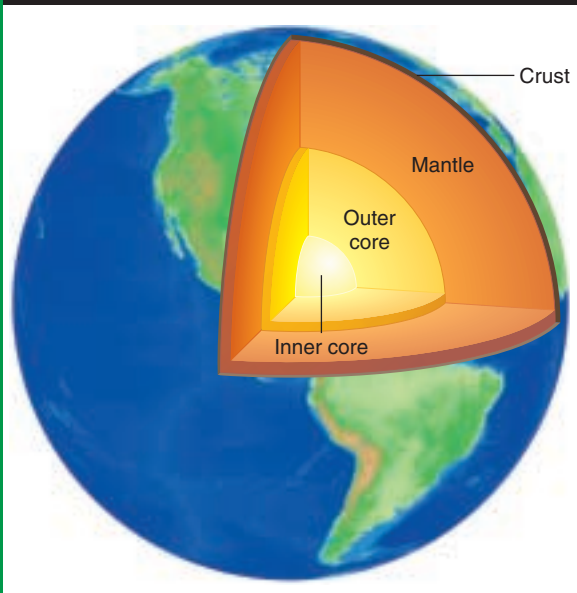


Although we cannot look into the center of the earth, scientists have concluded from available evidence that it is a dynamic interior of intense heat and pressure. Movements deep within the earth drive numerous changes that renew and enrich the earth's surface. In this section you will learn about the earth's structure and the natural forces that continually act upon our planet.

Earth's Structure

For hundreds of millions of years, the surface of the earth has been in slow but constant motion. Some forces that change the earth, such as wind and water, occur on the earth's surface. Others, such as volcanic eruptions and earthquakes, originate deep in the earth's interior.

Inside the Earth



Geography Skills for Life

- 1. Interpreting Diagrams** Which of Earth's layers is between the crust and the outer core?
- 2. Applying Geography Skills** How do the plates of the earth's crust shape the physical landscape?

A Layered Planet

As you see in the diagram above, the earth is composed of three layers—the core, the mantle, and the crust. At the very center of the planet is a super-hot but solid inner core. It lies about 4,000 miles (6,430 km) below the surface of the earth. Scientists believe that the inner core is made up of iron and nickel under enormous pressure.

Surrounding the inner core is a liquid outer core, about 1,400 miles (2,250 km) thick. A band of melted iron and nickel, the outer core begins about 1,800 miles (2,900 km) below the surface of the earth. Temperatures there reach a scalding 8,500°F (about 4,700°C).

Next to the outer core is a thick layer of hot, dense rock called the **mantle**. The mantle consists of silicon, aluminum, iron, magnesium, oxygen, and other elements. This mixture continually rises,

cools, sinks, warms up, and rises again, releasing 80 percent of the heat generated from the earth's interior.

The outer layer is the crust, a rocky shell forming the earth's surface. This relatively thin layer of rock ranges from about 2 miles (3.2 km) thick under oceans to about 75 miles (121 km) thick under mountains. The crust is broken into more than a dozen great slabs of rock called plates that rest—or more accurately, float—on a partially melted layer in the upper mantle. The plates carry the earth's oceans and continents. The map on page 39 shows the boundaries of the various plates.

Plate Movement

If you had seen the earth from space 500 million years ago, the planet probably would not have looked at all like it does today. Many scientists believe that most of the landmasses forming our present-day continents were once part of one gigantic supercontinent called *Pangaea* (pan•JEE•uh). Over millions of years, this supercontinent has broken apart into smaller continents. These continents in turn have drifted and, in some places, recombined. The theory that the continents were once joined and then slowly drifted apart is called **continental drift**.

Many scientists theorize that plates moving slowly around the globe have produced Earth's largest features—not only continents, but also oceans and mountain ranges. Most of the time, plate movement is so gradual—only about 4 inches (10 cm) a year—that it cannot be felt. As they move, the plates may crash into each other, pull apart, or grind and slide past each other. Whatever their actions, plates are constantly changing the face of the planet. They push up mountains, create volcanoes, and produce earthquakes. When the plates spread apart, **magma**, or molten rock, is pushed up from the mantle and ridges are formed. When the plates bump together, one may slide under another, forming a trench.

Scientists use the term **plate tectonics** to refer to all of these activities, which create many of the earth's physical features. Many scientists estimate that plate tectonics have been shaping the earth's surface for 2.5 to 4 billion years. According to some scientists, plate tectonics will have sculpted a whole new look for our planet millions of years from now.

Scientists, however, have not yet determined exactly what causes plate tectonics. They theorize that heat rising from the earth's core may create slow-moving currents within the mantle. Over millions of years, these currents of molten rock may shift the plates around, but the movements are extremely slow and difficult to detect.

Internal Forces of Change

The surface of the earth has changed greatly over time. Scientists believe that some of these changes come from internal forces associated with plate tectonics. One of these internal forces relates to the slow movement of magma within the earth. Other internal forces involve movements that can fold, lift, bend, or break the rock along the earth's crust.

Colliding and Spreading Plates

Mountains are formed in areas where giant continental plates collide. For example, the Himalaya ranges in South Asia were thrust upward when the Indian landmass rammed into Eurasia. Himalayan peaks are still getting higher as the Indian landmass continues to push against them.

Mountains also are created when a sea plate collides with a continental plate. In a process called **subduction** (suhb•DUHK•shuhn), the heavier sea plate dives beneath the lighter continental plate. Plunging into the earth's interior, the sea plate becomes molten material. Then, as magma, it bursts through the crust to form volcanic mountains. The Andes, for example, were formed over millions of years as a result of the process of subduction.

NATIONAL GEOGRAPHIC
MAP STUDY

Plates and Plate Movement

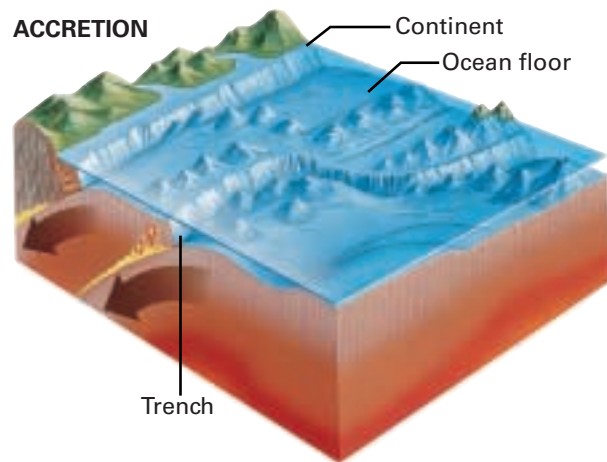
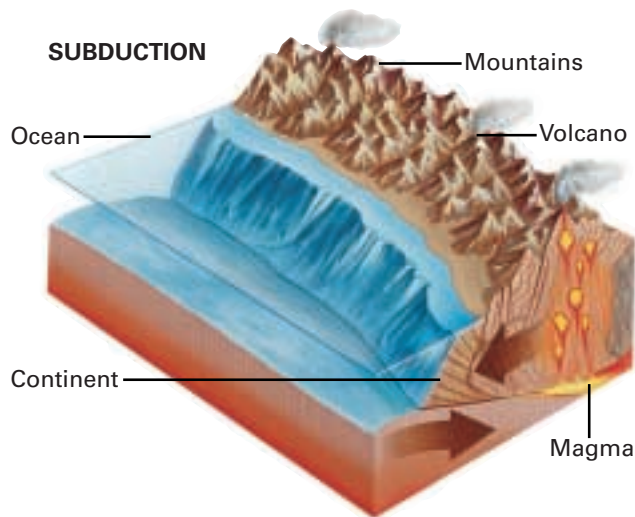
Plate boundary
➔ Direction of plate movement

Geography
Skills for Life

1. **Interpreting Maps** Which plates are moving toward each other? Away from each other?
2. **Applying Geography Skills** Identify and describe physical features that are the result of plate movement.

Find NGS online map resources @ www.nationalgeographic.com/maps

Forces of Change



In other cases where continental and sea plates meet, a different process, known as accretion, occurs. During **accretion** (uh•KREE•shuhn), pieces of the earth's crust come together slowly as the sea plate slides under the continental plate. This plate movement levels off seamounts, underwater mountains with steep sides and sharp peaks, and piles up the resulting debris in trenches. Such a buildup can cause continents to grow outward. Most scientists believe that much of western North America expanded outward over more than 200 million years as a result of the process of accretion.

New land is also created where two sea plates converge. In this process one plate moves under the other, often forming an island chain at the boundary. Sea plates also can pull apart in a process known as **spreading**. The resulting rift, or deep crack, allows magma from within the earth to well up between the plates. The magma hardens to build undersea volcanic mountains or ridges. This spreading activity occurs down the middle of the Atlantic Ocean's floor, pushing Europe and North America away from each other.

Folds and Faults

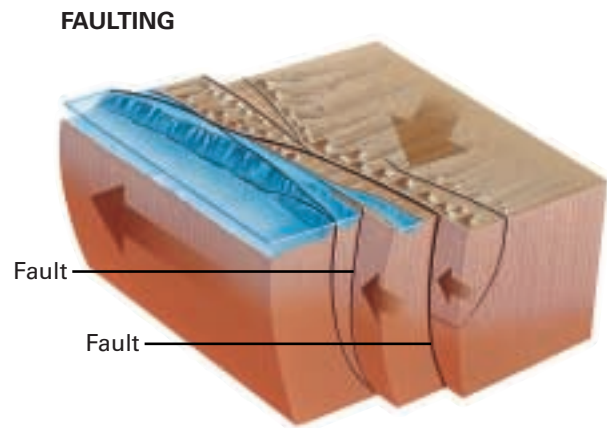
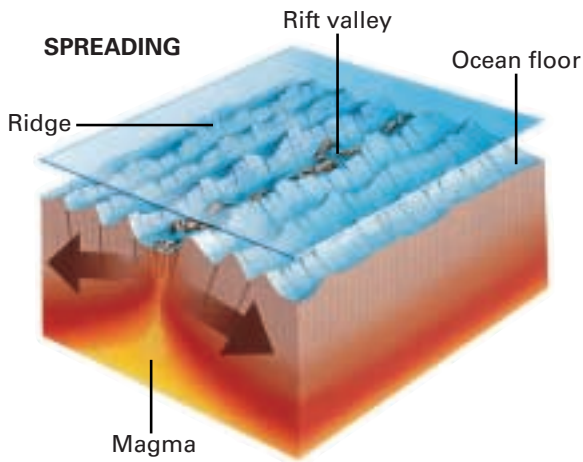
Moving plates sometimes squeeze the earth's surface until it buckles. This activity forms **folds**, or bends, in layers of rock. In other cases plates may grind or slide past each other, creating cracks in the earth's crust called **faults**. One famous fault is the **San Andreas Fault** in California.

The process of faulting occurs when the folded land cannot be bent any further. Then the earth's crust cracks and breaks into huge blocks. The blocks move along the faults in different directions, grinding against each other. The resulting tension may release a series of small jumps, felt as minor tremors on the earth's surface.

Earthquakes

Sudden, violent movements of plates along a fault line are known as earthquakes. These shaking activities dramatically change the surface of the land and the floor of the ocean. For example, during a severe earthquake in Alaska in 1964, a portion of the ground lurched upward 38 feet (11.6 m).

Earthquakes often occur where different plates meet one another. Tension builds up along fault



Geography Skills for Life

1. **Interpreting Diagrams** How does the process of accretion create deep trenches in the earth's surface?
2. **Applying Geography Skills** How do you think human settlement is affected by the process of faulting?

lines as the plates stick. The strain eventually becomes so intense that the rocks suddenly snap and shift. This movement releases stored-up energy along the fault. The ground then trembles as shock waves surge through it away from the area where the rocks snapped apart.

In recent years disastrous earthquakes have occurred in Kobe, Japan, and in Los Angeles and San Francisco, California. These cities are located along the **Ring of Fire**, one of the most earthquake-prone areas on the planet. The Ring of Fire is a zone of earthquake and volcanic activity surrounding the Pacific Ocean. It marks the boundary where the plates that cradle the Pacific meet the plates that hold the continents surrounding the Pacific.

Volcanic Eruptions

Volcanoes are mountains formed by lava or by magma that breaks through the earth's crust. Volcanoes often rise along plate boundaries where one plate plunges beneath another. This kind of volcanic formation occurs, for example, along the Ring of Fire. In such a process the rocky plate

melts as it dives downward into the hot mantle. If the molten rock is too thick, its flow is blocked and pressure builds. A cloud of ash and gas may then spew forth, creating a funnel through which the red-hot magma rushes to the surface. There the lava flow may eventually form a large volcanic cone topped by a crater, a bowl-shaped depression at a volcano's mouth.

Volcanoes also arise in areas away from plate boundaries. Some areas deep in the earth are hotter than others, and magma often blasts through the surface as volcanoes. As a moving plate passes over these hot spots, molten rock flowing out of the earth's surface may create volcanic island chains. An example of this type of formation is the Hawaiian Islands in the Pacific Ocean. At various hot spots, molten rock may also heat underground water, causing hot springs or geysers. Yellowstone National Park in Wyoming has many spectacular geysers formed by this process, such as Old Faithful, which regularly sends water and steam into the air.



▲ Water erosion in the Grand Canyon

External Forces of Change

External forces, such as wind and water, also change the earth's surface. They have transformed the planet's appearance over millions of years and continue to do so today. Wind and water movements involve two processes: weathering and erosion. **Weathering** is the process that breaks down rocks on the earth's surface into smaller pieces. **Erosion** is the wearing away of the earth's surface by wind, glaciers, and moving water.

Weathering

The earth is changed by two basic kinds of weathering—physical weathering and chemical weathering. Physical weathering occurs when large masses of rock are physically broken down into smaller pieces. For example, water seeps into the cracks in a rock and freezes, then expands and causes the rock to split.

The process of chemical weathering changes the chemical makeup of rocks, transforming their

minerals or combining them with new elements. For example, water mixed with carbon dioxide from the air easily dissolves certain rocks, such as limestone. Many of the world's caves have been and continue to be formed by this process.

Wind Erosion

Wind erosion involves the movement of dust, sand, and soil from one place to another. Plants help protect the land from wind erosion; however, in dry places where people have cut down trees and plants, winds pick up large amounts of soil and blow it away. Serious wind erosion devastated the Great Plains in the central United States during the 1930s. Fierce winds swept up dry, overworked soil from exposed farmland and carried it away in dust storms.

Wind erosion, however, also provides benefits. The dust carried by wind often forms large deposits of mineral-rich soil. These deposits provide fertile farmland in various parts of the world. China's Yellow River basin, for example, is thickly covered with **loess** (LEHS), a fertile, yellow-gray soil deposited by wind.

Glacial Erosion

Another cause of erosion is **glaciers**, or large bodies of ice that slowly move across the earth's surface. Glaciers form over a long period of time as layers of snow press together and turn to ice. Their great weight causes them to move slowly downhill or spread outward. As they move, glaciers pick up rocks and soil in their paths. Glacial movements change the landscape, destroying forests, carving out valleys, altering the courses of rivers, and wearing down mountaintops.

When glaciers melt and recede, in some places they leave behind large piles of rocks and debris called **moraines**. Some moraines form long ridges of land, while others form dams that hold water back and create glacial lakes.

There are two types of glaciers—sheet glaciers and mountain glaciers. Sheet glaciers are flat, broad sheets of ice. Today sheet glaciers cover most of Greenland and all of Antarctica. They advance a few feet each winter and recede during the summer. Large blocks of ice often break off from the coastal edges of sheet glaciers to become icebergs floating in the ocean.

Mountain glaciers are more common than sheet glaciers. They are located in high mountain valleys where the climate is cold, such as in the Rocky Mountains and Cascade Range of North America. As they move downhill, mountain glaciers gouge out round, U-shaped valleys. As these glaciers melt, rock and soil are deposited in new locations.

Water Erosion

Fast-moving water—rain, rivers, streams, and oceans—is the most significant cause of erosion. Water erosion begins when springwater and rainwater flow off the land downhill in streams. As the water flows, it cuts into the land, wearing away the soil and rock. The resulting sediment—small particles of soil, sand, and gravel—acts like sandpaper, grinding away the surface of rocks along the stream’s path. Over time, the eroding action of water forms first a gully and then a V-shaped valley. Sometimes valleys are eroded even further to form valleys with high, steep walls, called canyons. The Grand Canyon of the Colorado River is a good example of the eroding power of water. Peter Miller describes the canyon’s various layers as he hiked from the canyon rim to its floor:

“[A]s we hiked down the twisting Kaibab Trail to the Colorado River at the bottom of the canyon, we were hoping . . . to share a . . . great adventure. The canyon opened up before us with all the drama we had imagined. After we dropped below the ponderosa pine forests of the South Rim, we descended narrow ridgelines past crumbling cliffs of white sandstone, red limestone, chocolate sandstone, and maroon shale, descending 4,700 feet to the river.”

Peter Miller, “John Wesley Powell: Vision for the West,” *National Geographic*, April 1994

In addition to streams and rivers, oceans play an important role in water erosion. Pounding waves continually erode coastal cliffs, wear rocks into sandy beaches, and move sand away to other coastal areas. Violent storms speed up this process. In the next section, you will learn about the oceans and other water features of our planet and how they affect the earth’s surface.

TX TAKS Practice

SECTION 2 ASSESSMENT

Checking for Understanding

- 1. Define** mantle, continental drift, magma, plate tectonics, subduction, accretion, spreading, fold, fault, weathering, erosion, loess, glacier, moraine.
- 2. Main Ideas** Copy the organizer below, and fill in information about forces that shape Earth’s features. Then choose one force that shapes the earth’s surface and explain this process.

Forces of Change	
Composition (layers)	
Internal forces	
External forces	

Critical Thinking

- 3. Predicting Consequences** Based on your understanding of plate tectonics, what changes would you predict to the earth’s appearance millions of years from now?
- 4. Making Inferences** Think about water erosion associated with rivers and streams. Based on that information, what would you expect the areas where rivers empty into the oceans to be like? Explain.
- 5. Drawing Conclusions** In what ways can erosion be both beneficial and harmful to agricultural communities?

Analyzing Maps

- 6. Region** Study the map of plates and plate movement on page 39. Which plates are responsible for the earthquakes that have occurred in California in the United States?

Applying Geography

- 7. Consequences of Earth’s Forces** Review how internal forces shape the surface of the earth. Now imagine that the mantle ceased to circulate molten rock. Write a description of how land formation on the surface of the earth would be different.



A Global Concern:

Until a few centuries ago, plants and animals living in one part of the world rarely mixed with those on other continents. This changed, however, as new ways of transport allowed more and more people to travel the planet. A turning point was the Columbian Exchange, the transfer of plants, animals, and diseases between Europe and the Americas that began with the voyages of Columbus. Since then, the biological exchange has become global. As a result, thousands of “alien” plants and animals have been introduced into areas where the species do not occur naturally. Some introduced species are beneficial, while others are invasive and pose environmental threats.

Invasive Species



If you live near a wetland, you've probably seen the purple or pinkish flowers of the purple loosestrife (left). Native to Europe, purple loosestrife was brought to the United States as a garden plant. It soon spread to wetlands, where it now threatens native plants. Invasive species such as purple loosestrife are a global problem.

Sometimes invasive species arrive in new environments by accident—as seeds or as eggs or tiny insects hidden in packing materials, in food or soil, or in the ballast water of visiting ships. Without natural predators in their new habitats, alien species can multiply at alarming rates and crowd out native species. These invaders also can cause widespread environmental damage. The gypsy moth, for example, was accidentally introduced to the United States in the late 1800s. The insect, during its caterpillar stage, feeds on the leaves of several kinds of trees. Gypsy moth caterpillars have destroyed huge swaths of American forests.

Workers (below) cut invasive water hyacinths clogging waters in India. Yet some imported plants are beneficial. In Turkey (right), women harvest wheat to feed their families. ▼

Plants and animals are also introduced into new environments intentionally. For example, an insect might be imported to combat a crop pest. Some introduced species have turned out to be great successes. Wheat, for example, originated in the Middle East and is now grown on almost every continent. Spanish explorers brought horses to the Americas.

Yet for every helpful introduction, there have been many destructive ones. In 1859 British settlers released two dozen rabbits in Australia. Now millions of rabbits roam the continent. They devour crops and grasslands, creating deserts in the hot, dry climate. Water hyacinth, another invasive species, went from South America to Africa for use in ornamental ponds. The fast-growing plant soon spread to lakes and rivers, forming dense mats that interfere with boating and fishing.

Some scientists argue that alien species are serious threats to biodiversity. These people want laws to limit trade and to



◀ A gypsy moth caterpillar kills trees by eating their leaves.

halt the spread of plants and animals from place to place. Many biologists think using foreign species to control pests is too risky. Scientists cite numerous examples of introduced species that have damaged their new environments.

Some farmers and economists point out that in a world where trade and transportation bring countries together, a global redistribution of species is inevitable. Such people, fearing financial losses, oppose laws that limit trade. Farmers generally support importing foreign species to control pests. These biological controls cause less environmental damage than the use of pesticides.

What's Your Point of View?

Should international trade be restricted to limit the risks of spreading invasive species around the world?



Guide to Reading

Consider What You Know

Think of the ways you use water every day. Where does that water come from? Do you think it will always be available?

Read to Find Out

- How does the amount of water on Earth remain fairly constant?
- How is the water that makes up 70 percent of Earth's surface distributed?
- Why is freshwater important to humans?

Terms to Know

- water cycle
- evaporation
- condensation
- precipitation
- desalination
- groundwater
- aquifer

Places to Locate

- Pacific Ocean
- Atlantic Ocean
- Indian Ocean
- Arctic Ocean

Earth's Water

NATIONAL
GEOGRAPHIC

A Geographic View

Under the Arctic Ocean

In a world that's been almost completely mapped, it's easy to forget why cartographers used to put monsters in the blank spots. Today we got a reminder. The submarine captain had warned us that we were in uncharted waters. . . . Yet the first days of our cruise through this ice-covered ocean, Earth's least explored frontier, were . . . smooth. . . . Even when we passed over a mile-high mountain that no one on the planet knew existed, the reaction was one of quiet enthusiasm—"Neat."

—Glenn Hodges, "The New Cold War: Stalking Arctic Climate Change by Submarine," National Geographic, March 2000



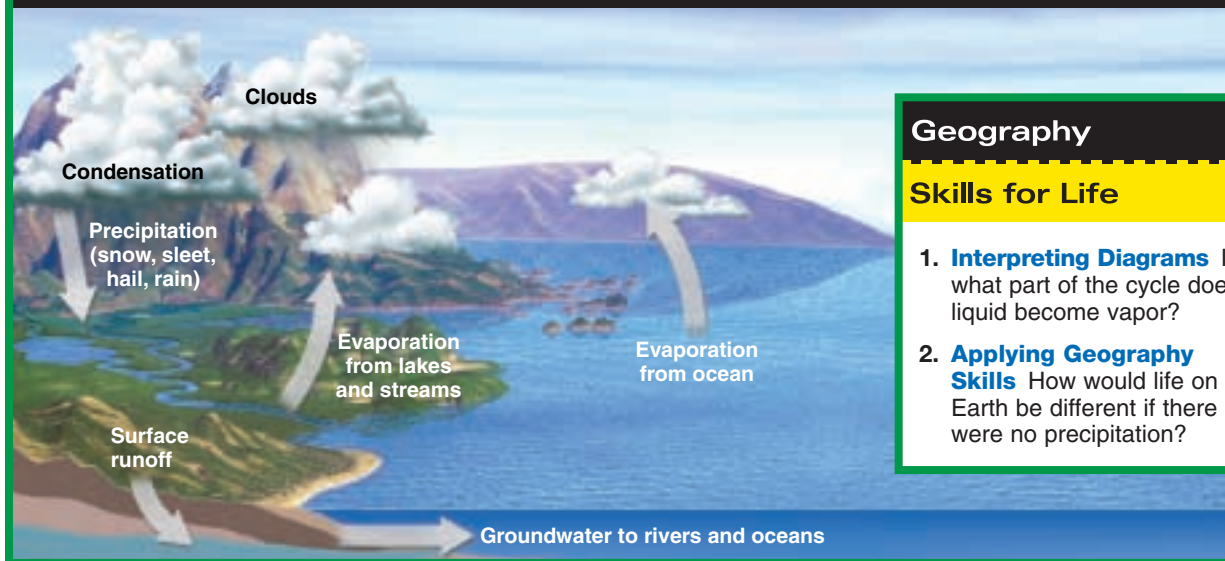
Navy submarine in the Arctic

A submarine crew investigating the Arctic Ocean can still experience the thrill of exploring uncharted territory—one of Earth's last frontiers. Although humans live mostly on land, water is important to our lives, and all living things need water to survive. Rivers, lakes, and oceans contain water in liquid form. The atmosphere holds water vapor, or water in the form of a gas. Glaciers and ice sheets are water in solid form. In this section you will learn about Earth's water and its importance to human life.

The Water Cycle

As you recall, oceans, lakes, rivers, and other bodies of water make up a part of the earth called the hydrosphere. Almost all of the hydrosphere is salt water found in the oceans, seas, and a few large saltwater lakes. The remainder is freshwater found in lakes, rivers, and springs.

The Water Cycle



Geography

Skills for Life

- 1. Interpreting Diagrams** In what part of the cycle does liquid become vapor?
- 2. Applying Geography Skills** How would life on Earth be different if there were no precipitation?

The total amount of water on the earth does not change, but the earth’s water is constantly moving—from the oceans to the air to the ground and finally back to the oceans. The **water cycle** is the name given to this regular movement of water. The diagram above shows the major parts of the water cycle.

The sun drives the cycle by evaporating water from the surfaces of oceans, lakes, and streams. **Evaporation** is the changing of liquid water into vapor, or gas. The sun’s heat causes evaporation. Water vapor rising from the oceans, other bodies of water, and plants is gathered in the air. The amount of water vapor the air holds depends on its temperature. Warm, less dense air holds more water vapor than does cool air.

When warm air cools, it cannot retain all of its water vapor, so the excess water vapor changes into liquid water—a process called **condensation**. Tiny droplets of water come together to form clouds. When clouds gather more water than they can hold, they release moisture, which falls to the earth as **precipitation**—rain, snow, or sleet, depending on the air temperature and wind conditions. This precipitation sinks into the ground and collects in streams and lakes to return to the

oceans. Soon most of it evaporates, and the cycle begins again.

The amount of water that evaporates is approximately the same amount that falls back to the earth. This amount varies little from year to year. Thus, the total volume of water in the water cycle is more or less constant.

Bodies of Salt Water

Seen from space, the earth’s oceans and seas are more prominent than the landmasses. As mentioned earlier, about 70 percent of the earth’s surface is water, but almost all of it is salt water. Freshwater makes up only a small percentage of Earth’s water.

Oceans

About 97 percent of the earth’s water consists of a huge, continuous body of water that circles the planet. Geographers divide this enormous expanse into four oceans: the **Pacific**, the **Atlantic**, the **Indian**, and the **Arctic**. The Pacific, the largest of the oceans, covers more area than all the earth’s land combined. The Pacific Ocean is also deep enough in some places to cover Mount Everest, the world’s highest mountain, with more than 1 mile (1.6 km) to

spare. The immense size of Earth's oceans continues to inspire awe and fascination in humans.

“It is useless to speculate at great length about why the sea has such a hold on us. Its mystery, its seeming infinity must be part of the reason. . . . And along with its vastness comes a visible, enduring wildness. We can raze the Amazonian rain forest if we like; we can settle the Alaskan tundra or the Arabian desert given the right economic incentives. We cannot, to the same extent, tame the ocean. . . .”

Robert Kunzig, *The Restless Sea: Exploring the World Beneath the Waves*, 1999

Seas, Gulfs, and Bays

Seas, gulfs, and bays are bodies of salt water smaller than oceans. These bodies of water are often partially enclosed by land. The Mediterranean Sea, one of the world's largest seas, is almost entirely encircled by southern Europe, northern Africa, and southwestern Asia. The Gulf of Mexico is nearly encircled by the coasts of the United States and Mexico. Scientists have identified 66 separate seas, gulfs, and bays, and many smaller divisions.

Economics

Ocean Water to Drinking Water

Although 97 percent of the world's water is found in oceans, the water is too salty for drinking, farming, or manufacturing. Today efforts focus on ways to meet the world's increasing need for freshwater, such as turning ocean water into freshwater by removing the salt. This process, known as **desalination**, is still in the early stages of development. Because desalination is expensive, only a small amount of freshwater is obtained this way. Even so, certain countries in



Geography Skills for Life

Kuwait Towers These towers—Kuwait's most famous landmark—have restaurants, an observation deck, and reservoirs storing 2 million gallons (7.6 million l) of desalinated water.

Human-Environment Interaction Why are scientists looking for ways to increase the amount of freshwater?

Southwest Asia and North Africa use desalination because other freshwater sources are scarce.

Bodies of Freshwater

Only about 3 percent of the earth's total water supply is freshwater, and most is not available for human consumption. More than 2 percent of Earth's total water supply is frozen in glaciers and ice caps. The Antarctic ice cap, for example, contains more freshwater than the rest of the world's regions combined. Another 0.5 percent is found beneath the earth's surface. Lakes, streams, and rivers contain far less than 1 percent of the earth's water.

CLICK HERE



Student Web Activity Visit the **Glencoe World Geography** Web site at tx.geography.glencoe.com and click on Student Web Activities—Chapter 2 for an activity about the earth's oceans.

Lakes, Streams, and Rivers

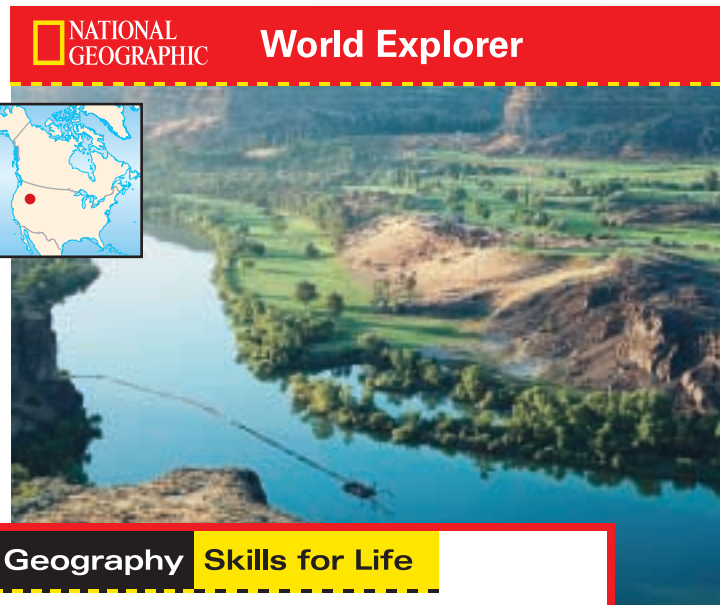
A lake is a body of water completely surrounded by land. Most lakes contain freshwater, although some, such as Southwest Asia's Dead Sea and Utah's Great Salt Lake, are saltwater remnants of ancient seas. Most lakes are found where glacial movement has cut deep valleys and built up dams of glacial soil and rock that held back melting ice-water. North America has thousands of glacial lakes.

Flowing water forms streams and rivers. Meltwater, an overflowing lake, or a spring may be the source, or beginning, of a stream. Streams may combine to form a river, a larger stream of higher volume that follows a channel along a particular course. When rivers join, the major river systems that result may flow for thousands of miles. Rain, runoff, and water from tributaries or branches swell rivers as they flow toward a lake, gulf, sea, or ocean. The place where the river empties into another body of water is its mouth.

Although lakes, streams, and rivers hold only a small part of the earth's water, they meet important needs. Most large urban areas began as settlements along the shores of lakes and rivers, where people would have a constant supply of water.

Groundwater

Groundwater, freshwater which lies beneath the earth's surface, comes from rain and melted snow that filter through the soil and from water that seeps into the ground from lakes and rivers. Wells



Geography Skills for Life

Freshwater The Snake River in southern Idaho provides vital freshwater for agriculture.

Human-Environment Interaction How have freshwater sources affected the development of human settlements?

and springs tap into groundwater and are important sources of freshwater for people in many rural areas and in some cities. An underground porous rock layer often saturated with water in the form of streams is called an **aquifer** (A•kwuh•fuhr). Aquifers and groundwater are important sources of freshwater.

TAKS Practice

SECTION 3 ASSESSMENT

Checking for Understanding

- 1. Define** water cycle, evaporation, condensation, precipitation, desalination, groundwater, aquifer.
- 2. Main Ideas** Use a web like the one below to organize information about Earth's water features.



Critical Thinking

- 3. Drawing Conclusions** Use your knowledge of the water cycle to explain how droughts might occur.
- 4. Making Inferences** Why might salt water someday provide water for drinking, farming, and manufacturing?
- 5. Identifying Cause and Effect** How is drinking water contaminated by hazardous substances released on land or into rivers and lakes?

Analyzing Diagrams

- 6. Physical Geography** Look at the diagram of the water cycle on page 47. What source of water supplies wells and springs?

Applying Geography

- 7. Importance of Rivers** Many large urban areas developed in river basins. Write a description of how a river or rivers contributed to your community's development.



**TAKS
Practice**

Learning the Skill

Comparing and contrasting help you identify similarities and differences between two or more things. Understanding similarities and differences can help you make better judgments about those things. When you compare, you look for similarities. Things that share at least one common quality can be compared. When you contrast, you look for differences. Things that differ from one another in at least one way can be contrasted.

To compare and contrast, apply the following steps:

- **Decide which items you will compare and contrast.** In the example above, you might compare and contrast the states' populations or their climates.
- **Determine which characteristics you will use to compare and contrast items.** In the example, you might decide to focus on the population sizes or the average temperatures of the two states.
- **Identify the similarities and differences in these characteristics.** In the example, you might compare populations and contrast climates.
- **If possible, identify causes for the similarities and differences.** For example, a state may have a larger population because it has a warmer climate.

Comparing and Contrasting

Do you have a friend or relative who lives in a different state? You may have talked about the similarities and differences in the places where you each live. If so, you have compared and contrasted those states.

Country	Languages	2001 Population (millions)	Government
Argentina	Spanish	37.5	Republic
Australia	English	19.4	Parliamentary democracy
Canada	English, French	31	Parliamentary democracy
France	French	59.2	Republic
Japan	Japanese	127.1	Constitutional monarchy
Kenya	English, Swahili	29.8	Republic

Source: Population Reference Bureau, 2001

Practicing the Skill

Study the chart above to answer the following questions.

1. What characteristics are used to compare and contrast the countries in the chart?
2. Which are the two smallest countries in population size? Which country is the largest?
3. How do Argentina and Japan differ in their population sizes? How do they differ in their governments?
4. How are Kenya, Canada, and Australia similar in the languages spoken?
5. Which two countries can you infer probably share similar cultural characteristics? Explain your answer.

Applying the Skill

With a partner, select four U.S. cities to research. Decide on at least three characteristics, such as population or land area, to compare and contrast. Collect the information for each of the three characteristics for each city. Design and draw a chart using your information. Develop three questions based on the chart. Exchange your work with another pair of students to answer the questions.



The **Glencoe Skillbuilder Interactive Workbook, Level 2** provides instruction and practice in key social studies skills.



SECTION 1

Planet Earth (pp. 33–36)

Terms to Know

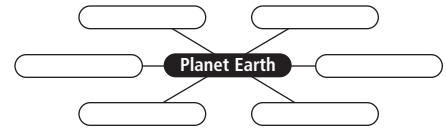
- hydrosphere
- lithosphere
- atmosphere
- biosphere
- continental shelf

Key Points

- Planet Earth is located in our solar system.
- The hydrosphere (water), lithosphere (land), and atmosphere (air) make Earth's biosphere suitable for plant and animal life.
- Great contrasts exist in the heights and depths of the earth's surface.

Organizing Your Notes

Use a web like the one below to help you organize information about Planet Earth.



SECTION 2

Forces of Change (pp. 37–43)

Terms to Know

- mantle
- continental drift
- magma
- plate tectonics
- subduction
- accretion
- spreading
- fold
- fault
- weathering
- erosion
- loess
- glacier
- moraine

Key Points

- Planet Earth is composed of three layers—the core, the mantle, and the crust.
- Plates that move slowly around the globe produced Earth's largest features—continents, oceans, and mountain ranges.
- Mountains and islands are created by internal forces called subduction and accretion.
- Internal forces, such as earthquakes and volcanoes, also shape the surface of the earth.
- External forces, such as weathering and wind, glacial, and water erosion, also shape the surface of the earth.

Organizing Your Notes

Create a series of flowcharts like the ones below to show which forces or physical processes shape Earth's various and distinctive landforms.

Effects of Earth's Forces

Landform	Shaped by Force(s)
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<input type="text"/>	→ <input type="text"/>
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SECTION 3

Earth's Water (pp. 46–49)

Terms to Know

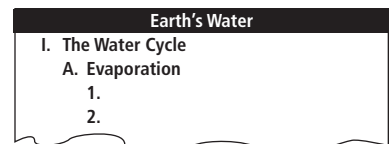
- water cycle
- evaporation
- condensation
- precipitation
- desalination
- groundwater
- aquifer

Key Points

- The amount of water on Earth remains fairly constant and moves in the water cycle.
- Water makes up 70 percent of the earth's surface.
- Earth's water features are classified as salt water or freshwater.
- Freshwater is necessary to sustain human life.

Organizing Your Notes

Create an outline using the format below to organize this section's notes.



Reviewing Key Terms

Write the key term that best completes each of the following sentences. Refer to the Terms to Know in the Summary & Study Guide on page 51.

- Four parts of the earth's surface are _____, _____, _____, and _____.
- Underwater trenches are created through the process of _____.
- The theory that continents are slowly moving is called _____.
- An _____ is an underground porous rock layer often saturated with water.
- A _____ is a bend in layers of rock.
- Water vapor changes into liquid through _____.
- _____ is molten rock within the earth.
- Moisture that falls from the clouds is _____.
- A _____ is a break in the earth's crust.
- The activity of the earth's moving plates is called _____.
- Liquid water changes into water vapor through the process of _____.
- _____ wears away the earth's surface.

Reviewing Facts

SECTION 1

- What are two types of planets?
- What are the four major types of landforms found on Earth?

SECTION 2

- Describe the earth's layers.
- What produced some of Earth's largest landforms?

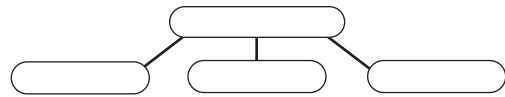
SECTION 3

- What process keeps the amount of Earth's water constant?

- Describe the forms that water takes throughout the water cycle.

Critical Thinking

- Comparing and Contrasting** How do internal and external forces of change affect Earth's surface differently?
- Making Inferences** How might the relationship among climate, vegetation, soil, and geology affect distribution of plants and animals in different regions?
- Finding and Summarizing the Main Idea** Copy the graphic organizer below, and write the main idea of each section in the outer ovals and the main idea of the chapter in the center oval. Write a summary using appropriate vocabulary.

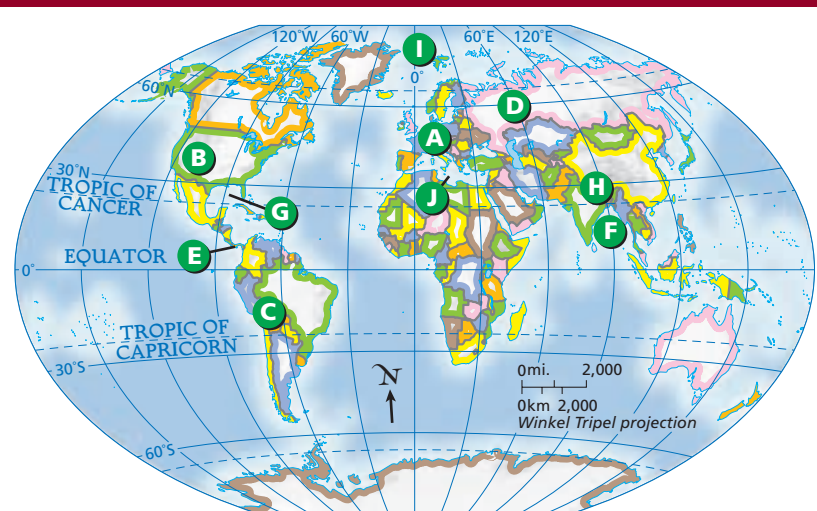


Locating Places

The Earth: Physical Geography

Match the letters on the map with the physical features of Earth. Write your answers on a sheet of paper.

- | | | |
|----------------------|-------------------|----------------------|
| 1. Rocky Mountains | 5. Himalaya | 8. Mediterranean Sea |
| 2. Isthmus of Panama | 6. Ural Mountains | 9. Bay of Bengal |
| 3. Gulf of Mexico | 7. Arctic Ocean | 10. Europe |
| 4. Andes | | |





Self-Check Quiz Visit the **Glencoe World Geography** Web site at tx.geography.glencoe.com and click on Self-Check Quizzes—Chapter 2 to prepare for the Chapter Test.

Thinking Like a Geographer

Think about the ways in which geographers classify the earth’s physical features. As a geographer, in what other ways might you classify those features? What would your reasons be for classifying features differently? Identify different classification systems that may be helpful to geographers.

Problem-Solving Activity

Problem-Solution Proposal Using the Internet and library resources, learn more about a specific location where freshwater is scarce and the reasons for the scarcity. Then write a proposal identifying the problem and explaining possible solutions for the scarcity. Choose one solution, and give reasons why you think it is the best alternative. Include charts, graphs, or other data that will help readers understand the basis for your conclusions.

GeoJournal

Descriptive Writing Use the journal entries you wrote in your GeoJournal as you read this chapter. Pick one feature, structure, or force of change, and write an expanded description of it. Paint a word picture using concrete, specific details. Consider sights, sounds, smells, and textures associated with the feature. Be sure to organize your description in an order that guides your reader through your composition.



Technology Activity

Using the Internet for Research

Choose one of the earth’s features, such as mountains, lakes, or rivers. Use the Internet to find specific examples of that feature in different parts of the world. Note the measurement for each and the continent where it is located. Organize your findings in a chart. If, for example, you choose rivers as a feature to research, you might include headings such as longest river, widest river, swiftest river, highest volume river, and so on. Then write a summary, ranking the continents by the sizes of their features.



TAKS Test Practice

Use the information in the chart below to answer the questions. If you have trouble answering the questions, use the process of elimination to narrow your choices.

Notable Volcanic Eruptions			
Year	Volcano	Location	Deaths (est.)
1631	Mt. Vesuvius	Italy	4,000
1783	Laki	Iceland	9,350
1883	Krakatau	Indonesia	36,000
1902	Mt. Pelée	Martinique	28,000
1980	Mt. St. Helens	United States	57
1991	Mt. Pinatubo	Philippines	800

- Based on the information shown in the chart, in which century did the deadliest eruption occur?
 - A seventeenth
 - B eighteenth
 - C nineteenth
 - D twentieth
- The chart probably contains data from the past 300+ years because
 - F more volcanoes erupted then.
 - G more information is available.
 - H no volcanoes erupted before 1631.
 - J eruptions are getting closer together.



Test-Taking Tip Look at the chart title to see what kind of information is presented. For question 1, find out what categories are being compared. Identify which eruption caused the greatest number of deaths. Then, identify in which century it occurred. Question 2 asks you to infer causes. Note the chart’s title, which gives a clue to the answer.