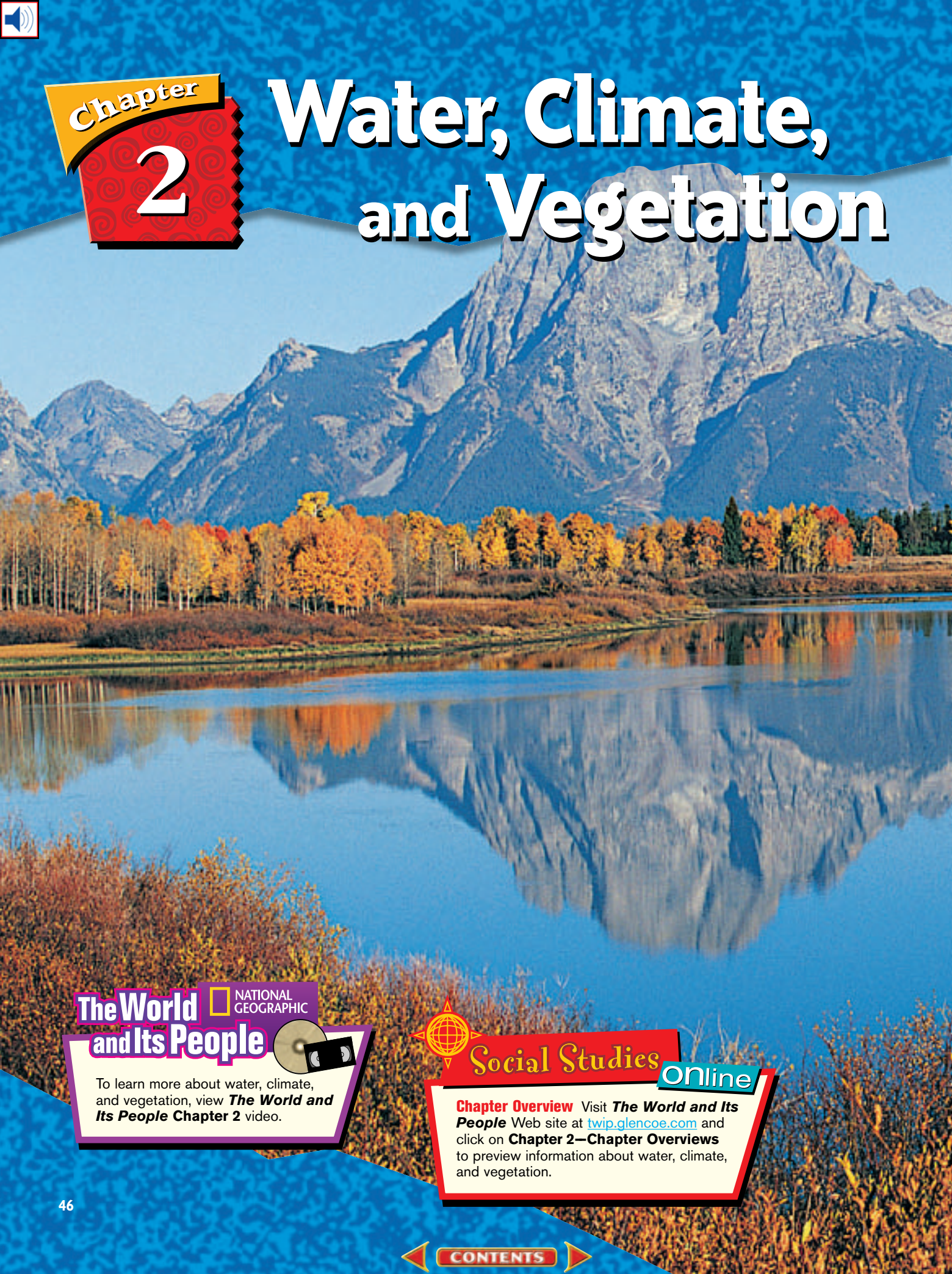
Chapter 2

Water, Climate, and Vegetation



The World and Its People NATIONAL GEOGRAPHIC

To learn more about water, climate, and vegetation, view ***The World and Its People*** **Chapter 2** video.

Social Studies ONLINE

Chapter Overview Visit ***The World and Its People*** Web site at twip.glencoe.com and click on **Chapter 2—Chapter Overviews** to preview information about water, climate, and vegetation.

CONTENTS

Why It Matters

A Balancing Act

Many of the daily decisions you make pertain to the weather and climate. Climate affects where you live, what you wear, what you eat, and what activities you participate in. Climate also affects what types of vegetation will grow in certain areas. Understanding climate—and the human activities that can change it—is the first step in understanding the need to have a balance in the global environment.

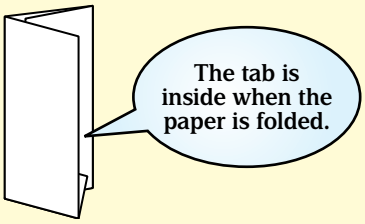
◀ Grand Teton National Park, Wyoming, United States

FOLDABLES™ Study Organizer

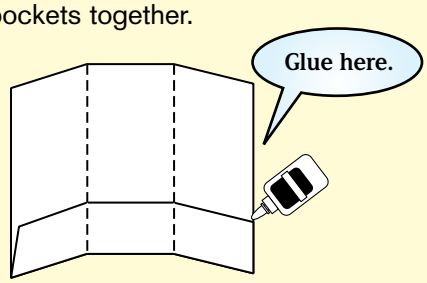
Summarizing Make this foldable and use it to organize note cards with information about water, climate, and vegetation.

Step 1 Fold a two-inch tab along the long edge of a sheet of paper.

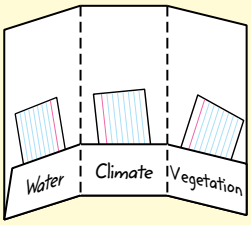
Step 2 Fold the paper in thirds so the tab is on the inside.



Step 3 Open the paper pocket foldable, turn it, and glue the edges of the pockets together.



Step 4 Label the pockets as shown.



Reading and Writing As you read each section in the chapter, summarize key facts about water, climate, and vegetation on note cards or on quarter sheets of notebook paper. Organize your notes by placing them in your foldable inside the appropriate pocket.

Section 1

The Water Planet

Guide to Reading

Main Idea

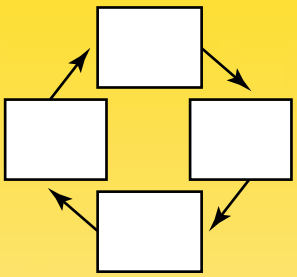
Water is one of the earth's most precious resources.

Terms to Know

- water vapor
- water cycle
- evaporation
- condensation
- precipitation
- collection
- glacier
- groundwater
- aquifer

Reading Strategy

Draw a diagram like this one. Starting at the top, write the steps of the water cycle—each in a separate square—in the correct sequence.



Interactive Graphic Organizer

NATIONAL GEOGRAPHIC Exploring Our World

Humans, trees, other plants, and animals all need water. We cannot survive without it. Here, a swimmer enjoys a remarkable sight—a permanent pool of water in the middle of Mexico's Chihuahuan Desert. The water bubbles to the surface from an underground spring. The clear water does more than attract swimmers, though. It supports a variety of animal and plant life.

Some people call Earth "the water planet." Why? Water covers about 70 percent of the earth's surface. Water exists all around you in many different forms. Streams, rivers, lakes, seas, and oceans contain water in liquid form. The atmosphere holds **water vapor,** or water in the form of gas. Glaciers and ice sheets are masses of water that have been frozen solid. As a matter of fact, the human body itself is about 60 percent water.

The Water Cycle

The total amount of water on the earth does not change. It does not stay in one place, either. Instead, the water moves constantly. In a process called the **water cycle,** the water goes from the oceans to the air to the ground and finally back to the oceans.

Look at the diagram on page 49 to see how the water cycle works. The sun drives the cycle by evaporating water mostly from the surface of oceans, but also from lakes and streams. In **evaporation,** the sun's heat turns liquid water into water vapor—also called humidity. The amount of water vapor that the air holds depends on the air

temperature. Warm air can hold more humidity than cool air. This explains those warm, muggy summer days.

In addition, warm air tends to rise. As warm air rises higher in the atmosphere, it cools. The cooler air loses its ability to hold as much humidity. As a result, the water vapor changes back into a liquid in a process called **condensation.** Tiny droplets of water come together to form clouds. Eventually, the water falls back to the earth as some form of **precipitation**—rain, snow, sleet, or hail—depending on the temperature of the surrounding air.

When this precipitation reaches the earth's surface, it soaks into the ground and collects in streams and lakes. During **collection,** streams and rivers both above and below the ground carry the water back to the oceans. Then the cycle begins again.

Reading Check **Which kind of air—warm or cold—holds the most water vapor?**

Water Resources

It is a hot day, and you rush home for a glass of water. Like all other people, and all plants and animals, you need water to survive. Think about the many ways you use water in a single day. You use it to bathe, to brush your teeth, to cook your food, and to quench your thirst. People and most animals need freshwater to live. Other creatures make their homes in the earth's more plentiful kind of water: salt water.

Freshwater Only about 2 percent of the water on the earth is freshwater. Eighty percent of that freshwater is frozen in polar ice caps or **glaciers,** which are giant sheets of ice. Only a tiny fraction of all freshwater—not even four-hundredths of a percent—is found in lakes and rivers.

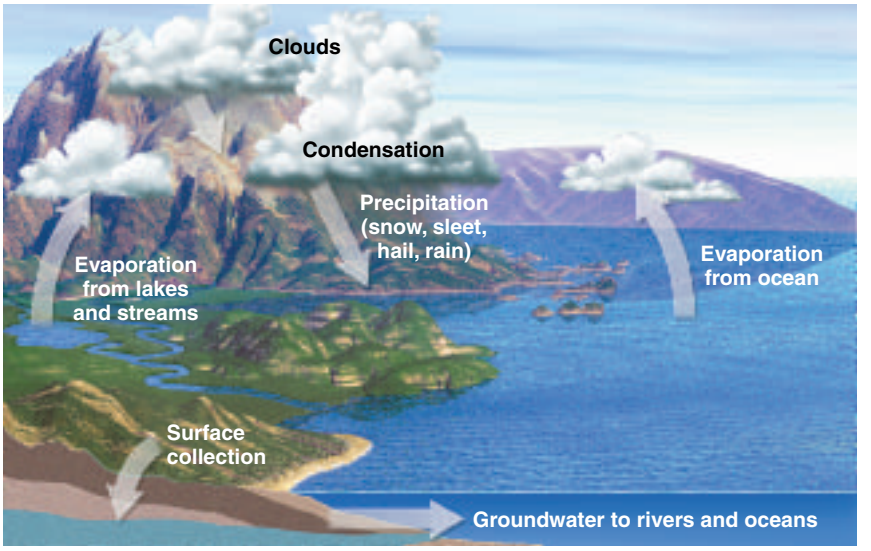
NATIONAL GEOGRAPHIC

The Water Cycle

Analyzing the Diagram

The water cycle involves evaporation, condensation, precipitation, and the collection of water above and below the ground.

Movement **How does water get from the ground to the oceans?**



When you think of freshwater, you probably think of mighty rivers and huge lakes. People can get freshwater from another source, though. **Groundwater** is water that fills tiny cracks and holes in the rock layers below the surface of the earth. This is a vital source of water because there is 10 times more groundwater than there is water in rivers and lakes. Groundwater can be tapped by wells. Some areas have **aquifers,** or underground rock layers that water flows through. In regions with little rainfall, both farmers and city dwellers sometimes have to depend on aquifers and other groundwater for most of their water supply.

Salt Water All the oceans on the earth are part of a huge, continuous body of salt water—almost 98 percent of the planet's water. Look at the map on page 57. You will see that the four major oceans are the **Pacific Ocean,** the **Atlantic Ocean,** the **Indian Ocean,** and the **Arctic Ocean.**

The Pacific Ocean is the largest and deepest of these four oceans. It covers almost 64 million square miles (166 million sq. km)—more than all the land areas of the earth combined. As you learned in Chapter 1, bodies of salt water smaller than the oceans are called seas, gulfs, bays, or straits. Look back at the diagram on pages 14–15 of the **Geography Handbook** to see these features again.

Reading Check **What is the difference between groundwater and aquifers?**

Assessment

Defining Terms

1. **Define** water vapor, water cycle, evaporation, condensation, precipitation, collection, glacier, groundwater, aquifer.

Recalling Facts

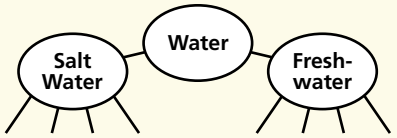
2. **Region** What percentage of the earth is covered by water?
3. **Movement** In which part of the water cycle does water return to the earth?
4. **Region** What are the world's four oceans?

Critical Thinking

5. **Understanding Cause and Effect** How does the temperature of the air affect the amount of humidity that you feel? How does the air's temperature also influence the form of precipitation that falls?
6. **Drawing Conclusions** Why do you think it is important to keep groundwater free of dangerous chemicals?

Graphic Organizer

7. **Organizing Information** Draw a diagram like this one. List at least four sources of freshwater and salt water on the lines under each heading.



Interactive Graphic Organizer

Applying Social Studies Skills

8. **Analyzing Diagrams** Look at the diagram of the water cycle on page 49. From where does water evaporate?

Making Connections

ART | SCIENCE | CULTURE | TECHNOLOGY

Exploring Earth's Water

More than two-thirds of the earth's surface is covered with water, yet scientists know more about the surface of the moon than they do about the ocean floor. Using an AUV, or autonomous underwater vehicle, called *Autosub,* researchers hope to gain a new understanding about the earth's watery surface.

What It Does

It looks like a giant torpedo, but *Autosub* is really a battery-powered robotic submarine that is 23 feet (7 m) long. Its mission is to explore parts of the ocean that are beyond the reach of other research vessels or are too dangerous for humans. Although it is still being tested, *Autosub* has already conducted hundreds of underwater missions.

Exploring Ice Shelves

One of the most promising areas of research for *Autosub* lies in seawater under the ice shelves near Greenland in the Arctic and near Antarctica at the southern extreme of the globe. Traditional submarines are unable to explore these places safely. Satellite photographs show that the area of the ice shelves is changing. Scientists want to use *Autosub*'s technology to measure changes in the thickness of sea ice. They believe that this information may give important clues about the possible rise in the earth's temperature.

Sea ice plays an important role in keeping the earth's climate stable. It acts as insulation—a kind of protection—between the ocean and the atmosphere. Sea ice reflects light, so it limits the amount of heat absorbed into the water. This keeps the ocean from getting too warm. In winter, sea ice helps prevent heat from escaping the warmer oceans into the atmosphere.

What the Future Holds

So far, *Autosub*'s missions have been fairly short. Scientists hope to someday program *Autosub* to make long voyages, sampling seawater and collecting data from ocean floors. The information that *Autosub* provides will help scientists make better predictions about the earth's climate.

▲ ***Autosub*** **can be launched from shore, towed out to sea by a small boat, or lowered by a crane into the water.**

Making the Connection

1. What is *Autosub*?
2. Why do scientists want to use *Autosub* to explore under the ice shelves?
3. **Understanding Cause and Effect** How could a loss of sea ice affect the earth's climate?

Section 2

Climate

Guide to Reading

Main Idea

Wind and water carry rainfall and the sun's warmth around the world to create different climates.

Terms to Know

- weather
- climate
- Tropics
- drought
- El Niño
- La Niña
- current
- local wind
- rain shadow
- greenhouse effect
- rain forest

Reading Strategy

Create a chart like this one. Write at least two details that explain how each force contributes to climate.

Sun	Wind	Water

Interactive Graphic Organizer

NATIONAL GEOGRAPHIC Exploring Our World

Most summers, warm winds blow over South Asia. Full of water vapor, these warm winds meet colder air and unleash heavy rains. The rains last for months—but life goes on. Here in Dhaka, the capital of Bangladesh, a worker carries poultry baskets to a market. Even water that reaches waist-high does not stop life in this busy city.

Why are some areas of the world full of lush forests, while others are covered with bone-dry deserts? Why do some people struggle through chilling winters, while others enjoy a day at the beach? To understand these mysteries, you need to unlock the secrets of climate.

Weather and Climate

As you learned in Chapter 1, the earth is surrounded by the atmosphere, which holds a combination of gases we call air. The many layers of the atmosphere protect life on the earth from harmful rays of the sun. The layer of atmosphere closest to the earth is also where you will find weather patterns. Suppose a friend calls you and asks what it is like outside. You might say, "It's a beautiful day—warm and sunny!" You are describing the weather. **Weather** refers to the unpredictable changes in air that take place over a short period of time.

Suppose that someone from another country asks what summers and winters are like in your area. You might say, "Summers are usually hot and rainy, and winters are cool but dry." This answer describes not the weather but your area's climate. **Climate** is the usual, predictable

pattern of weather in an area over a long period of time. Studies of climate show the highs and lows of temperature and precipitation over the course of 30 years or more.

Reading Check **What is the difference between weather and climate?**

The Sun and Climate

What causes climate? The original source of climate is the sun. It gives off energy and light that all plants and animals need to survive. The sun's rays warm the air, water, and land on our planet. Warm gases and liquids are lighter than cool gases and liquids. Because they are lighter, the warmer gases and liquids rise. Then wind and water carry this warmth around the globe, spreading the sun's heat.

Latitude and Climate Climate is also affected by the angle at which the sun's rays hit the earth. As you learned in Chapter 1, the sun's rays hit various places at different angles at different times of the year. These changes are caused by the earth's tilt and revolution around the sun. The sun's rays hit places in low latitudes—regions near the **Equator**—more directly than places at higher latitudes. The low latitudes near the Equator, known as the **Tropics,** lie between the **Tropic of Cancer** (23½°N latitude) and the **Tropic of Capricorn** (23½°S latitude). If you lived in the Tropics, you would almost always experience a hot climate, unless you lived high in the mountains where temperatures are cooler. Find the Tropics on the map on page 54. (To learn how to use latitude and longitude, turn to page 60.)

NATIONAL GEOGRAPHIC **On Location**

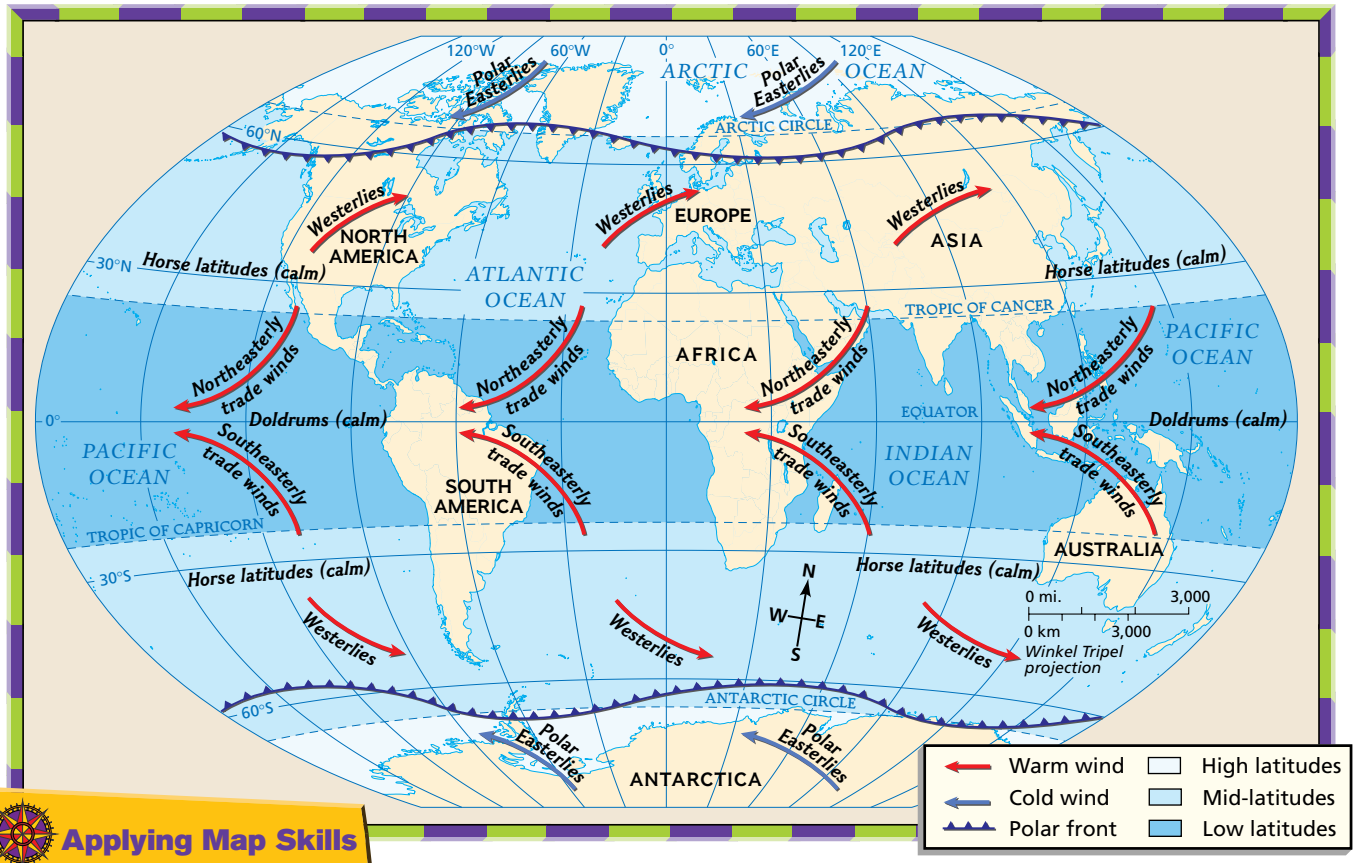
Washington, D.C.

A cross-country skier braves a blizzard in the capital of the United States.

Place **When scientists study climate, what two factors do they analyze?**

NATIONAL GEOGRAPHIC

Prevailing Wind Patterns



Applying Map Skills

1. In which general direction does the wind blow over North America?
2. What winds did European sailors use to get to South America and the islands north of it?

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

Outside the Tropics, the sun is never directly overhead. The mid-latitudes extend from the Tropics to about 60° both north and south of the Equator. When the North Pole is tilted toward the sun, the sun's rays fall more directly on the Northern Hemisphere. This affects our climate by giving us warm summer days. Six months later, the South Pole is tilted toward the sun, and the seasons are reversed. At the high latitudes near the North and South Poles, the sun's rays hit very indirectly. Climates in these regions are always cool or cold.

Reading Check **How does the tilt of the earth affect climate?**

The Wind's Effect on Climate

Movements of air are called winds. From year to year, winds follow prevailing, or typical, patterns. These patterns are very complex. One reason is that winds do more than move east and west or north and south. They also go up and down. As you learned earlier, warm air rises and cold air falls. Thus, the warmer winds near the Equator rise and move north and south toward the Poles of the earth. The colder winds from the Poles sink and move toward the Equator. This exchange is complicated by the fact that the earth rotates, which causes the winds to curve. Winds, then, are in constant motion in many directions.

Another important wind pattern is the monsoon. Monsoons are tremendous seasonal winds that blow over continents for months at a time. They are found mainly in Asia and some areas in Africa. Although they often are destructive, the summer monsoons in South Asia bring much-needed heavy rains.

Storms As you read in Section 1, part of the water cycle is rain and other types of precipitation that fall to the earth. A little rain may ruin a picnic or spoil a ball game, but it is not a serious problem. Sometimes, though, people suffer through fierce storms. What causes these destructive events?

When warm, moist air systems meet cold air systems, thunderstorms may develop. These storms include thunder, lightning, and heavy rain. They tend to be short, lasting only about 30 minutes. Some areas are more likely to see thunderstorms than others. In central Florida, as many as 90 days per year may experience thunderstorms.

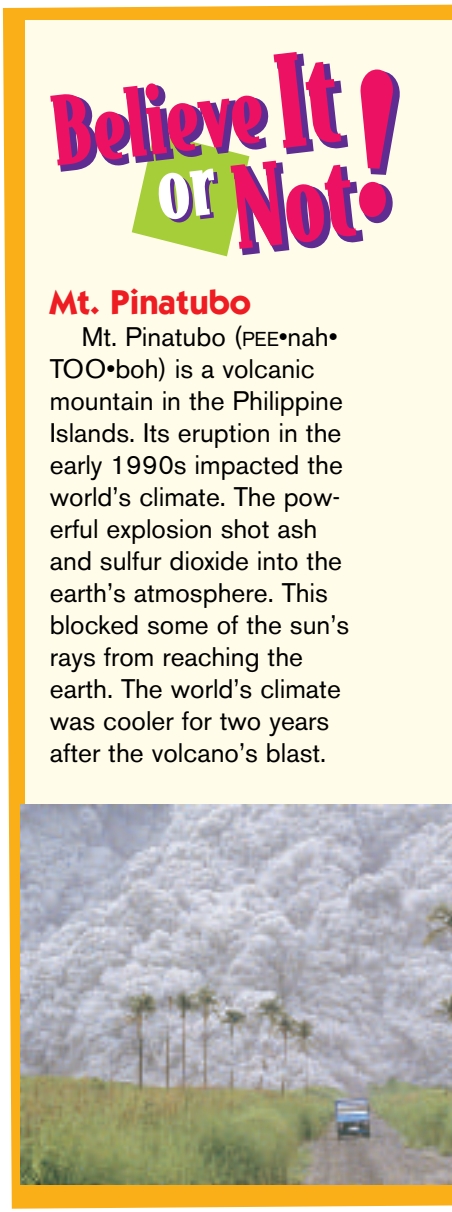
A thunderstorm can produce another danger—a tornado. Tornadoes are funnel-shaped windstorms that sometimes form during severe thunderstorms. They occur all over the world, but the United States has more tornadoes than any other area. Winds in tornadoes often reach 250 miles (402 km) per hour.

Hurricanes, or violent tropical storm systems, form over the warm Atlantic Ocean in late summer and fall. Hurricanes bring high winds that can reach more than 150 miles (241 km) per hour. They also produce rough seas and carry drenching rain. Hurricanes strike North America and the islands in the Caribbean Sea. They also rip through Asia, although in that region they are called typhoons. These storms can do tremendous damage. Their strong winds destroy buildings and snap power lines. Heavy rains can flood low-lying areas.

El Niño and La Niña In 1998 the world experienced unusual weather. Heavy rains brought floods to Peru, washing away whole villages. Europe, eastern Africa, and most of the southern United States also had severe flooding. In the western Pacific, normally heavy rains never came. Indonesia suffered a **drought,** a long period of extreme dryness. The land there became so dry that forest fires burned thousands of acres of trees. Thick smoke from the fires forced drivers to put their headlights on at noon!

Why did these disasters take place? They resulted from a combination of temperature, wind, and water effects in the Pacific Ocean called **El Niño** (ehl NEE•nyoh). The name "El Niño" was coined by early Spanish explorers in the Pacific. They used the phrase—which refers to the Christ child and means "the boy"—because the effect hits South America around Christmas.

El Niños form when cold winds from the east are weak. Without these cold winds, the central Pacific Ocean grows warmer than usual. More water evaporates, and more clouds form. The thick band of clouds changes wind and rain patterns. Some areas receive heavier than normal rains and others have less than normal rainfall.



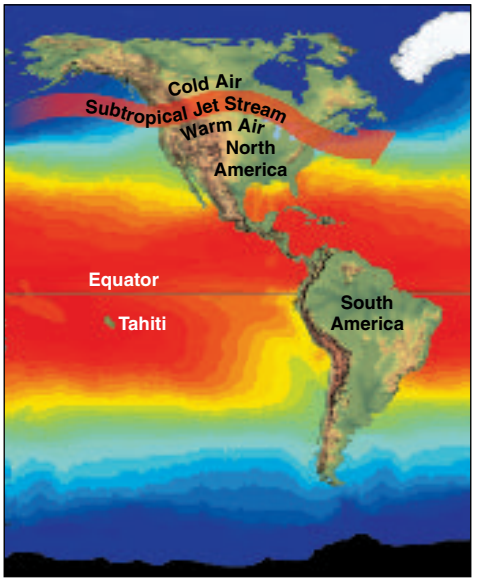
Mt. Pinatubo

Mt. Pinatubo (PEE•nah•TOO•boh) is a volcanic mountain in the Philippine Islands. Its eruption in the early 1990s impacted the world's climate. The powerful explosion shot ash and sulfur dioxide into the earth's atmosphere. This blocked some of the sun's rays from reaching the earth. The world's climate was cooler for two years after the volcano's blast.

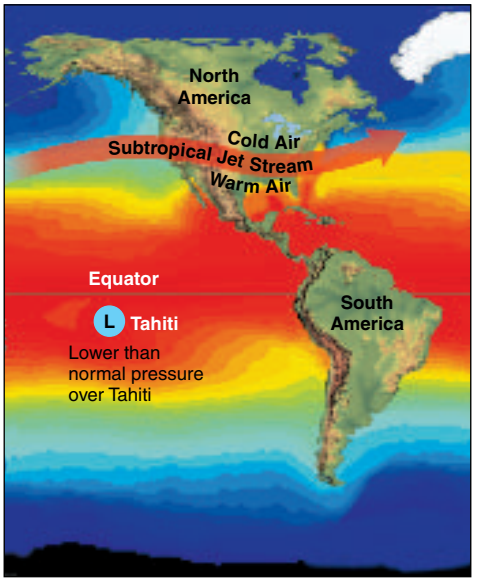
NATIONAL GEOGRAPHIC

El Niño

NORMAL CONDITIONS



EL NIÑO CONDITIONS



Analyzing the Diagram

The temperature of the oceans varies from warm (dark red) to very cold (dark purple).

Movement **What happens to the jet stream during El Niño conditions?**

Does El Niño happen every year? Scientists have found that El Niño occurs about every three years. They also found that in some years, the opposite kind of unusual weather takes place. This event is called **La Niña** (lah NEE•nyah), Spanish for "the girl," because the effects are the opposite of those in El Niño. Winds from the east become very strong, cooling more of the Pacific. When this happens, heavy clouds form in the western Pacific.

Reading Check **Why do El Niños occur?**

Ocean Currents

Winds carry large masses of warm and cool air around the earth. At the same time, moving streams of water called **currents** carry warm or cool water through the world's oceans. Look at the map on page 57. As you can see, these currents follow certain patterns. Notice how the warm currents tend to move along the Equator or from the Equator to the Poles. The cold currents carry cold polar water toward the Equator.

These currents affect the climate of land areas. Look at the warm current called the Gulf Stream. It flows from the Gulf of Mexico along the east coast of North America. Then it crosses the Atlantic Ocean toward Europe, where it is called the North Atlantic Current. Winds that blow over these warm waters bring warm air to western Europe. Because these winds blow from west to east, areas in Europe enjoy warmer weather than areas lying west of the Gulf Stream in Canada.

Reading Check **What areas of the world would be affected by a change in the Gulf Stream?**

Landforms and Climate

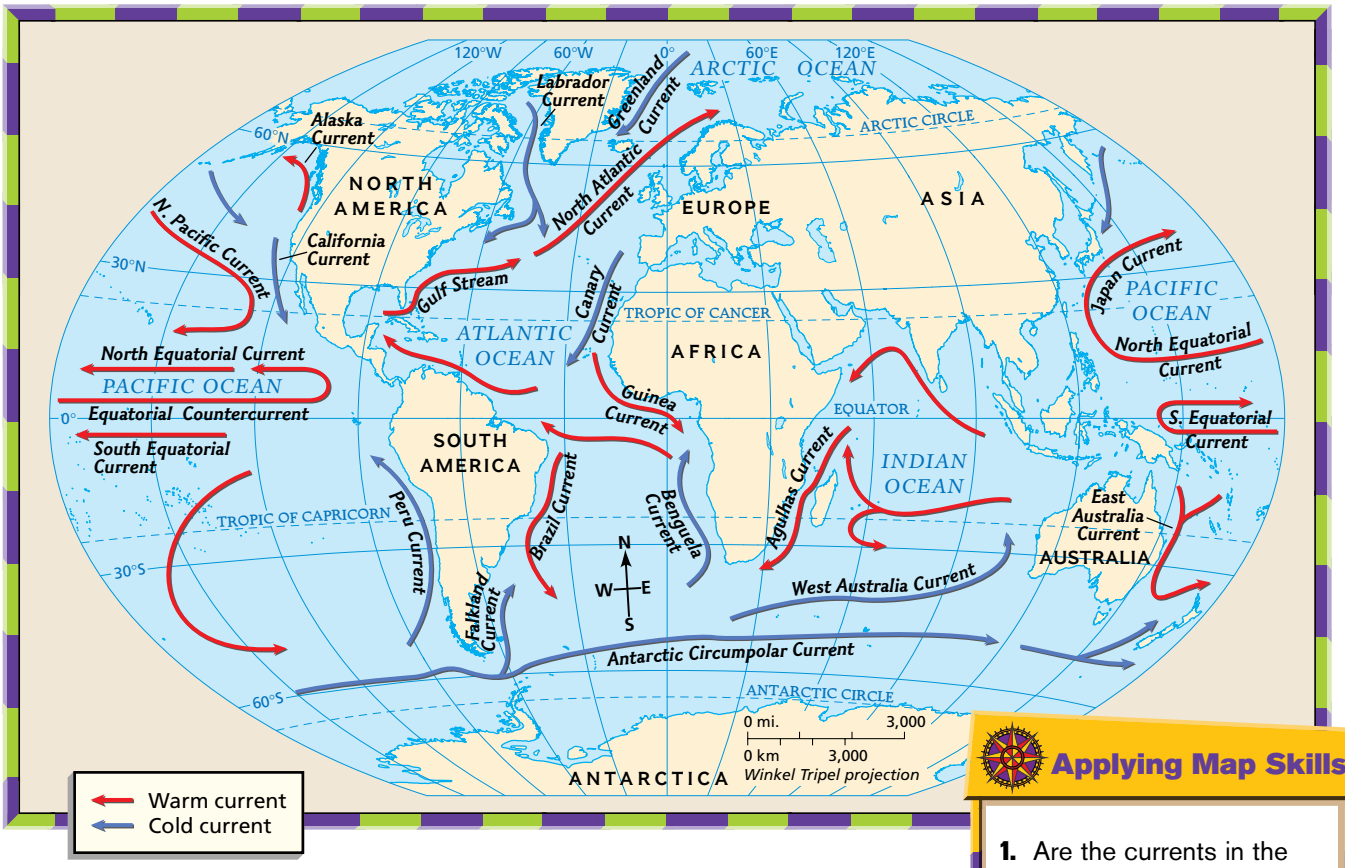
Wind and water affect climate, but the shape of the land has an effect on climate as well. Where the landforms are in relation to one another and to water influences climate too.

Landforms and Local Winds Although geographers study major wind patterns that blow over the earth, they also look at local winds. **Local winds** are patterns of wind caused by landforms in a particular area. Some local winds occur because land warms and cools more quickly than water does. As a result, cool sea breezes keep coastal areas cool during the

CONTENTS

NATIONAL GEOGRAPHIC

World Ocean Currents



Applying Map Skills

1. Are the currents in the Indian Ocean warm or cold?
2. Where does the Peru Current flow?

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

day. After the sun sets, the opposite occurs. The air over the land cools more quickly than the air over water does. At night, then, a cool breeze blows from the land out to the sea.

A similar effect occurs near mountains. Air warmed by the sun rises up mountain slopes during the day. At night, cooler air moves down the mountain into the valley below. Have you ever seen fog lying on a valley floor on a cool morning? That fog was caused by the cool air that came down the mountain during the night.

Mountains, Temperature, and Rainfall The higher the elevation of a particular place, the lower the temperature that place will have. In high mountains, the air becomes thinner and cannot hold as much heat from the sun. The temperature drops. Even in the Tropics, snow covers the peaks of high mountains.

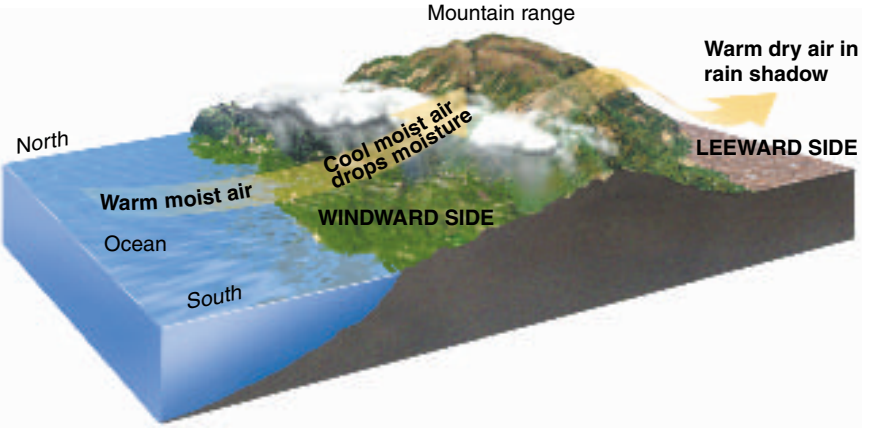
Mountains also have an effect on rainfall. When warm, moist winds blow inland from the ocean toward a coastal mountain range, the winds are forced upward over the mountains. As these warm winds rise, the air cools and loses its moisture. Rain or snow falls on the mountains. The climate on this windward—or wind-facing—side of mountain ranges is moist and often foggy. Trees are thick and green.

Rain Shadow

Analyzing the Diagram

Rain shadows usually occur on the leeward sides of mountain ranges.

Location **What is the term for the side of a mountain where the climate is moist and often foggy?**



By the time the air moves over the mountain peaks, it is cool and dry. This creates a **rain shadow,** a dry area on the side of the mountains facing away from the wind. Geographers call this side the leeward side. The dry air of a rain shadow warms up again as it moves down the leeward side, giving the region a dry or desert climate.

A rain shadow occurs along the western coast of the United States and Canada. Winds moving east from the Pacific Ocean lose their moisture as they move upward on the windward slopes of the coastal mountains. Great deserts and dry basins are located on the leeward side of these ranges.

Reading Check **Why are areas of higher elevation often cooler?**

The Impact of People on Climate

People's actions can affect climate. You may have noticed that temperatures in large cities are generally higher than those in nearby rural areas. Why is that? The city's streets and buildings absorb more of the sun's rays than do the plants and trees of rural areas.

Cities are warmer even in winter. People burn fuels to warm houses, power industry, and move cars and buses along the streets. This burning raises the temperature in the city. The burning also releases a cloud of chemicals into the air. These chemicals blanket the city and hold in more of the sun's heat, creating a so-called heat island.

The Greenhouse Effect In the past two hundred years, people have burned coal, oil, and natural gas as sources of energy. Burning these fuels releases certain gases into the air. Some scientists warn that the buildup of these gases presents dangers. It creates a **greenhouse effect**—like a greenhouse, the gases prevent the warm air from rising and escaping into the atmosphere. As a result, the overall temperature of the earth will increase. Some scientists predict disastrous results from this global warming. They say the ice at the North and South Poles will melt. Then ocean levels will rise and flood coastal cities. Some areas that are now fertile will become unable to grow crops.

Not all scientists agree about the greenhouse effect. Some argue that the world is not warming. Others say that even if it is, the predictions of disaster are extreme. Many scientists are studying world temperature trends closely. They hope to be able to discover whether the greenhouse effect is a real threat.

Clearing the Rain Forests Along the Equator, dense forests called **rain forests** receive high amounts of rain each year. In some countries, people are clearing large areas of these forests. They want to sell the lumber from the trees. They also want to use the land to grow crops or as pasture for cattle. Clearing the rain forests, though, can hurt the world's climate.

One danger is related to the greenhouse effect. People often clear the forests by burning down the trees. This burning releases more gases into the air, just like burning oil or natural gas does. Another danger of clearing the rain forests is related to rainfall. Remember the water cycle discussed in Section 1? Water on the earth's surface evaporates into the air and then falls as rain. In the rain forests, much of this water evaporates from the leaves of trees. If the trees are cut, less water will evaporate. As a result, less rain will fall. Scientists worry that over time the area that now holds rain forests will actually become dry and unable to grow anything.

Reading Check **What are two dangers of clearing the rain forests?**

Social Studies online

Web Activity Visit ***The World and Its People*** Web site at twip.glencoe.com and click on **Chapter 2—Student Web Activities** to learn more about the destruction of the rain forests.

Section 2 Assessment

Defining Terms

1. **Define** weather, climate, Tropics, drought, El Niño, La Niña, current, local wind, rain shadow, greenhouse effect, rain forest.

Recalling Facts

2. **Movement** What five elements affect climate?
3. **Location** Between what two lines of latitude are the Tropics?
4. **Place** Provide an example of how landforms influence climate.

Critical Thinking

5. **Making Comparisons** How does the amount of rainfall on the windward side of a mountain differ from that on the leeward side?
6. **Summarizing Information** What general patterns do wind and currents follow?

Interactive Graphic Organizer

Graphic Organizer

7. **Organizing Information** Draw a diagram as shown. First, list three human actions that lead to the greenhouse effect. In the third box, list four results of the greenhouse effect.

Applying Social Studies Skills

8. **Analyzing Maps** Look at the world ocean currents map on page 57. Which continent lies completely outside the Tropics?

Social Studies Skill

Using Latitude and Longitude

Learning the Skill

To find an exact location, geographers use a set of imaginary lines. One set of lines—**latitude** lines—circles the earth's surface like a stack of rings. The starting point for numbering latitude lines is the Equator, which is 0° latitude. Lines of latitude are numbered from 1° to 90° and are followed by an N or S to show whether they are north or south of the Equator. Latitude lines are also called parallels.

A second set of lines—**longitude** lines—runs vertically from the North Pole to the South Pole. These lines are also called meridians. The starting point—0° longitude—is called the Prime Meridian (or Meridian of Greenwich). Longitude lines are numbered from 1° to 180° followed by an E or W—to show whether they are east or west of the Prime Meridian.

To find latitude and longitude, choose a place on a map. Identify the nearest parallel, or line of latitude. Is it located north or south of the Equator? Now identify the nearest meridian, or line of longitude. Is it located east or west of the Prime Meridian?

Practicing the Skill

1. On the map below, what is the exact location of Washington, D.C.?
2. Which cities on the map lie south of 0° latitude?
3. Which city is located near 30°N, 30°E?

Applying the Skill

Turn to pages RA2–RA3 of the **Reference Atlas.** Determine the latitude and longitude for one city. Ask a classmate to use the information to find and name the city.

NATIONAL GEOGRAPHIC

Map of the World

Section 3

Climate Zones and Vegetation

Guide to Reading

Main Idea

Geographers divide the world into different climate zones.

Terms to Know

- savanna
- marine west coast climate
- Mediterranean climate
- humid continental climate
- humid subtropical climate
- subarctic
- tundra
- steppe

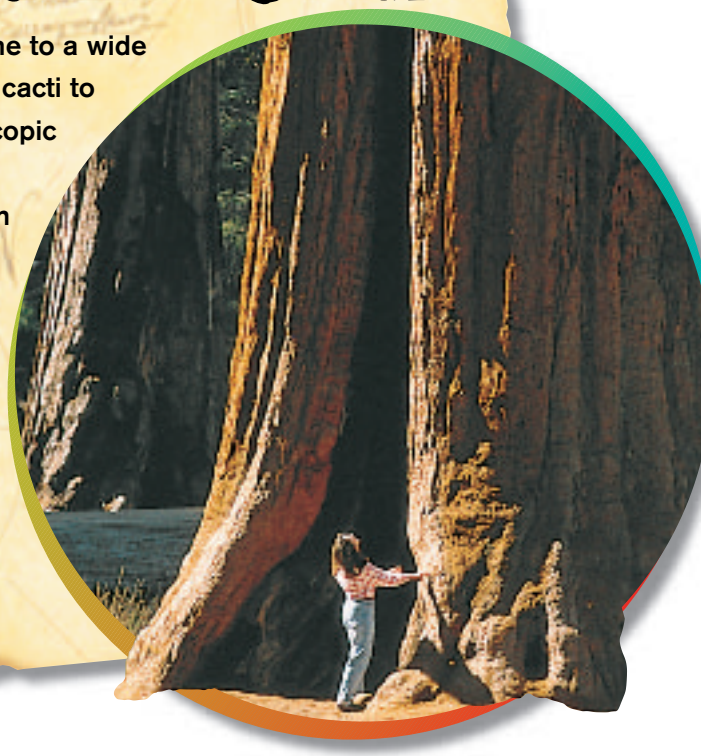
Reading Strategy

Create a chart like this one by listing the categories of each type of climate next to the correct headings.

Climate Type	Categories
Tropical	
Mid-Latitude	
High Latitude	
Dry	
Highland	

Interactive Graphic Organizer

NATIONAL GEOGRAPHIC Exploring Our World



The United States is home to a wide variety of plant life—from cacti to cattails and from microscopic mosses to giant trees. The incredible tree shown here is a giant sequoia. Although not the tallest, it is the largest of all trees. A few sequoias tower more than 300 feet (91 m) high and measure 100 feet (30 m) around at their base.

Why do you think a photograph of a giant tree is in a chapter on climate? The reason is that climate and vegetation go together. Consider this: The state of Washington sits next to the state of Idaho. The plant life in western Washington, however, is much more similar to that of the United Kingdom, which is thousands of miles away, than it is to the plant life in eastern Washington and Idaho, which touch each other. Why? The patterns of temperature, wind, and precipitation in western Washington and the United Kingdom are similar.

Scientists use these patterns to group climates into many different types. They have put the world's climates into five major groups: tropical, mid-latitude, high latitude, dry, and highland. Three of these groups—tropical, mid-latitude, and high latitude—are based on an area's latitude, or distance from the Equator. Some of these major groups have subcategories of climate zones within them. In addition, each climate zone has particular kinds of plants that grow in it.

Tropical Climates

The tropical climate gets its name from the Tropics—the areas along the Equator reaching from 23½°N to 23½°S. If you like warm weather, you would love a tropical climate. The tropical climate region can be separated into two types—tropical rain forest and tropical savanna. The tropical rain forest climate receives up to 100 inches (254 cm) of rain a year. As a result, the rain forest climate is wet in most months. The tropical savanna climate has two distinct seasons—one wet and one dry.

Tropical Rain Forest Climate Year-round rains in some parts of the Tropics produce lush vegetation and thick rain forests. These forests are home to millions of kinds of plant and animal life. Tall hardwood trees such as mahogany, teak, and ebony form the canopy, or top layer of the forest. The vegetation at the canopy layer is so thick that little sunlight reaches the forest floor. The Amazon Basin in South America is the world's largest rain forest area.

Tropical Savanna Climate In other parts of the Tropics, such as southern India and eastern Africa, rain falls in just a few months of the year. This is called the wet season. The rest of the year is hot and dry. **Savannas,** or broad grasslands with few trees, are the main type of vegetation in this climate region. Find the tropical savanna climate areas on the map on page 63.

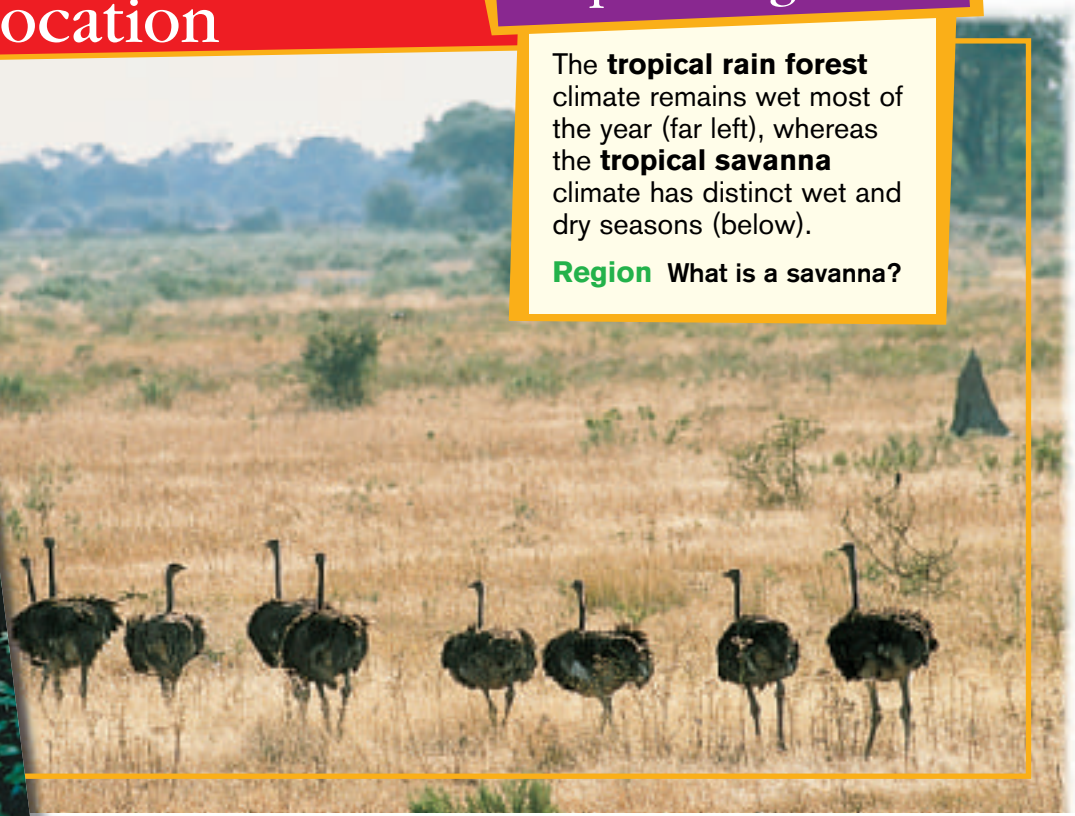
Reading Check **Where are the tropical climate zones found?**

NATIONAL GEOGRAPHIC **On Location**

Tropical Vegetation

The **tropical rain forest** climate remains wet most of the year (far left), whereas the **tropical savanna** climate has distinct wet and dry seasons (below).

Region **What is a savanna?**



NATIONAL GEOGRAPHIC

World Climate Regions

Applying Map Skills

1. Which climate covers most of the southeastern United States?
2. Which climate is most common in countries directly on the Equator?

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

Mid-Latitude Climates

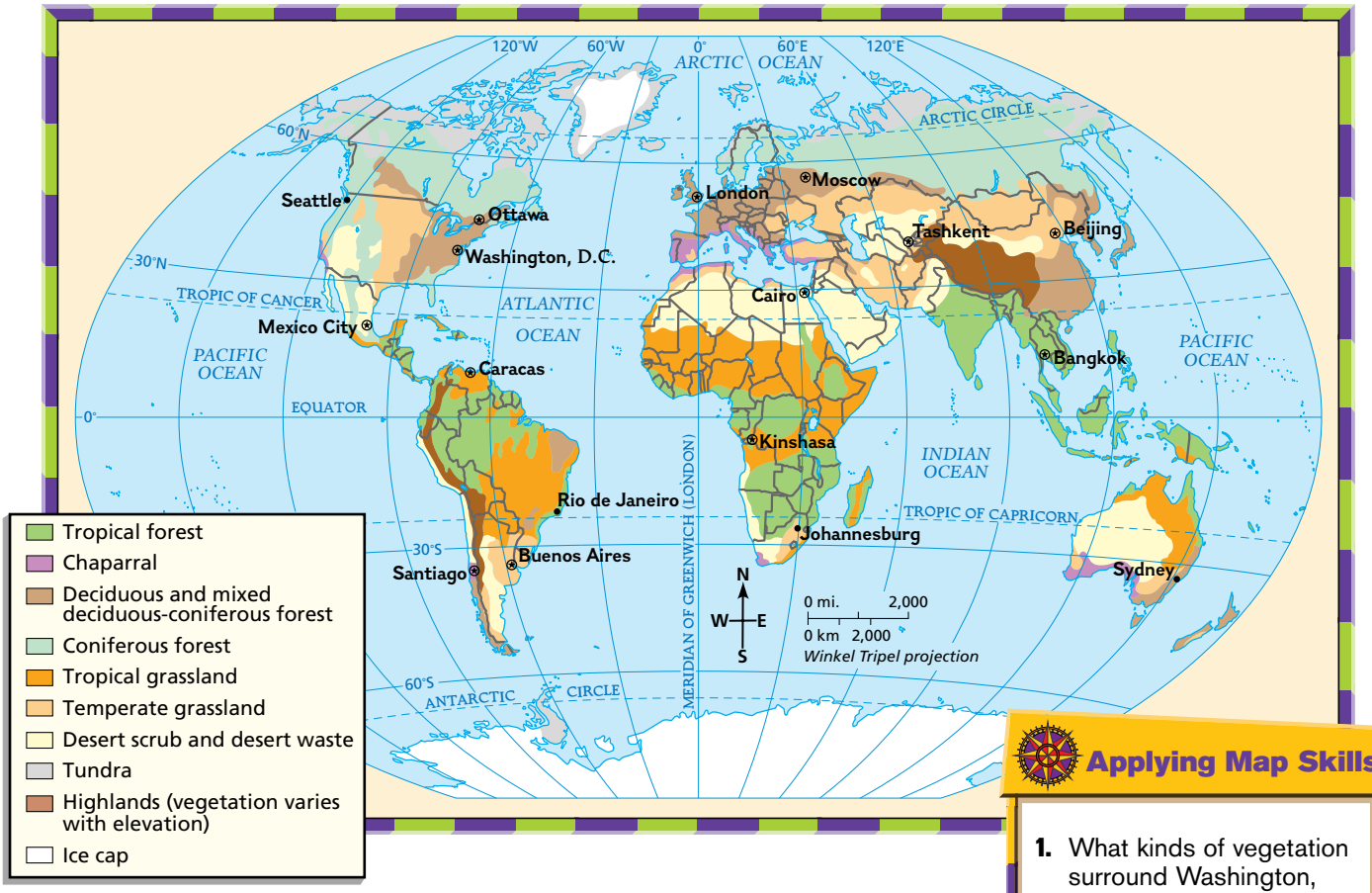
Mid-latitude, or moderate, climates are found in the middle latitudes of the Northern and Southern Hemispheres. They extend from about 23½° to 60° both north and south of the Equator. Most of the world's people—probably including you—live within these two bands around the earth. The climate zones found here are called mid-latitude because they are in the middle of both the Northern Hemisphere and the Southern Hemisphere. The mid-latitude climates are neither as close to the Equator as the tropical climates nor as close to the Poles as the high latitude climates.

The mid-latitude region includes more and different climate zones than other regions. This variety results from a mix of air masses. As you remember from Section 2, warm air comes from the Tropics. Cool air comes from the polar regions. In most mid-latitude climates, the temperature changes with the seasons. Sometimes the climate zones in this region are called temperate climates.

Marine West Coast Climate Coastal areas that receive winds from the ocean usually have a mild **marine west coast climate.** If you lived in one of these areas, your winters would be rainy and mild, and your summers would be cool. Most areas with this climate—such as

NATIONAL GEOGRAPHIC

World Natural Vegetation Regions



Applying Map Skills

1. What kinds of vegetation surround Washington, D.C., and Moscow?
2. What type of vegetation grows around Bangkok?

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

the northwestern United States—receive heavy rainfall. This supports the growth of deciduous trees, or those that lose their leaves in the fall. Coniferous forests, evergreens with cones and needles, also thrive.

Mediterranean Climate Another mid-latitude coastal climate is called a **Mediterranean climate** because it is similar to the climate found around the Mediterranean Sea. This climate has mild, rainy winters like the marine west coast climate. Instead of cool summers, however, people living in a Mediterranean climate experience hot, dry summers. The vegetation that grows in this climate includes chaparral, or shrubs and short trees. Some are evergreens, but others lose their leaves in the dry season.

Humid Continental Climate If you live in inland areas of North America, Europe, or Asia, you usually face a harsher **humid continental climate.** In these areas, winters can be long, cold, and snowy. Summers are short but may be very hot. Deciduous trees grow in forests, and vast grasslands flourish in some areas of this zone.

Humid Subtropical Climate Mid-latitude regions close to the Tropics have a **humid subtropical climate.** Rain falls throughout the year but is heaviest during the hot and humid summer months. Humid subtropical winters are generally short and mild. Trees like oaks, magnolias, and palms grow in this zone.

Reading Check **What causes the mid-latitude region to have more and different climate zones than other regions?**

High Latitude Climates

High latitude climate regions lie mostly in the high latitudes of each hemisphere, from 60°N to the North Pole and 60°S to the South Pole. These climates are generally cold, but some are more severely cold than others.

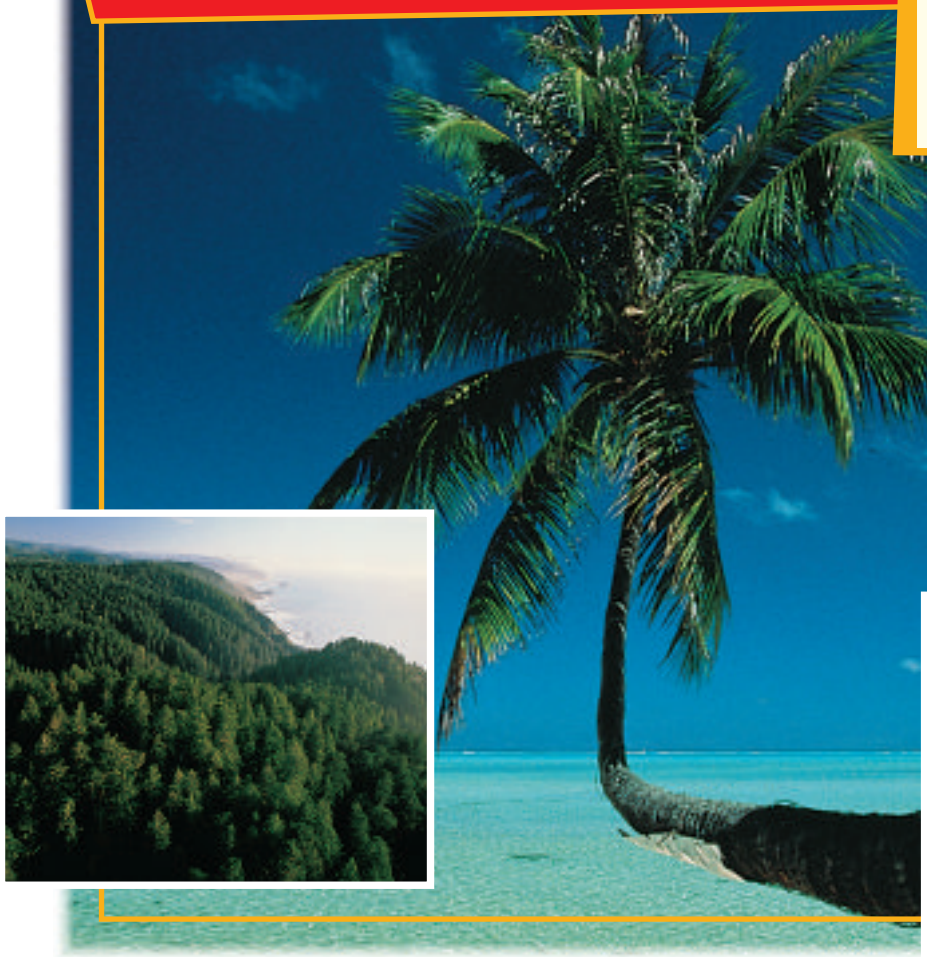
Subarctic Climate In the high latitudes nearest the mid-latitude zones, you will find the **subarctic** climate. The few people living here face very cold and bitter winters, but temperatures do rise above freezing during summer

Mid-Latitude Vegetation

Fir trees (bottom left) thrive in a **marine west coast** climate. Shrubs and olive trees (top right) grow in a **Mediterranean** climate. Deciduous trees (bottom right) flourish in a **humid continental** climate. Palm trees are common in **humid subtropical** zones.

Place **Which type of vegetation is most common in your area?**

NATIONAL GEOGRAPHIC On Location



months. Huge evergreen forests called taiga (TY•guh) grow in the subarctic region, especially in northern Russia.

Tundra Climate Closer to the Poles than the subarctic zone lie the **tundra** areas, or vast treeless plains. The climate in this zone is harsh and dry. In the tundra and parts of subarctic regions, the lower layers of soil are called permafrost because they stay permanently frozen. Only the top few inches of the ground thaw during summer months. Because of permafrost, melting snow does not seep into the ground. Instead, the tundra turns marshy during the summer. This provides the moisture that plants need to grow. Trees cannot set up roots, however, so only sturdy grasses and low bushes grow in the tundra.

Ice Cap Climate On the polar ice caps and the great ice sheets of Antarctica and Greenland, the climate is bitterly cold. Monthly temperatures average below freezing. Temperatures in Antarctica have been measured at −128°F (−89°C)! Although no other vegetation grows here, lichens—or funguslike plants and mosses—can live on rocks.

Reading Check **What are the three types of high latitude climates?**

NATIONAL GEOGRAPHIC

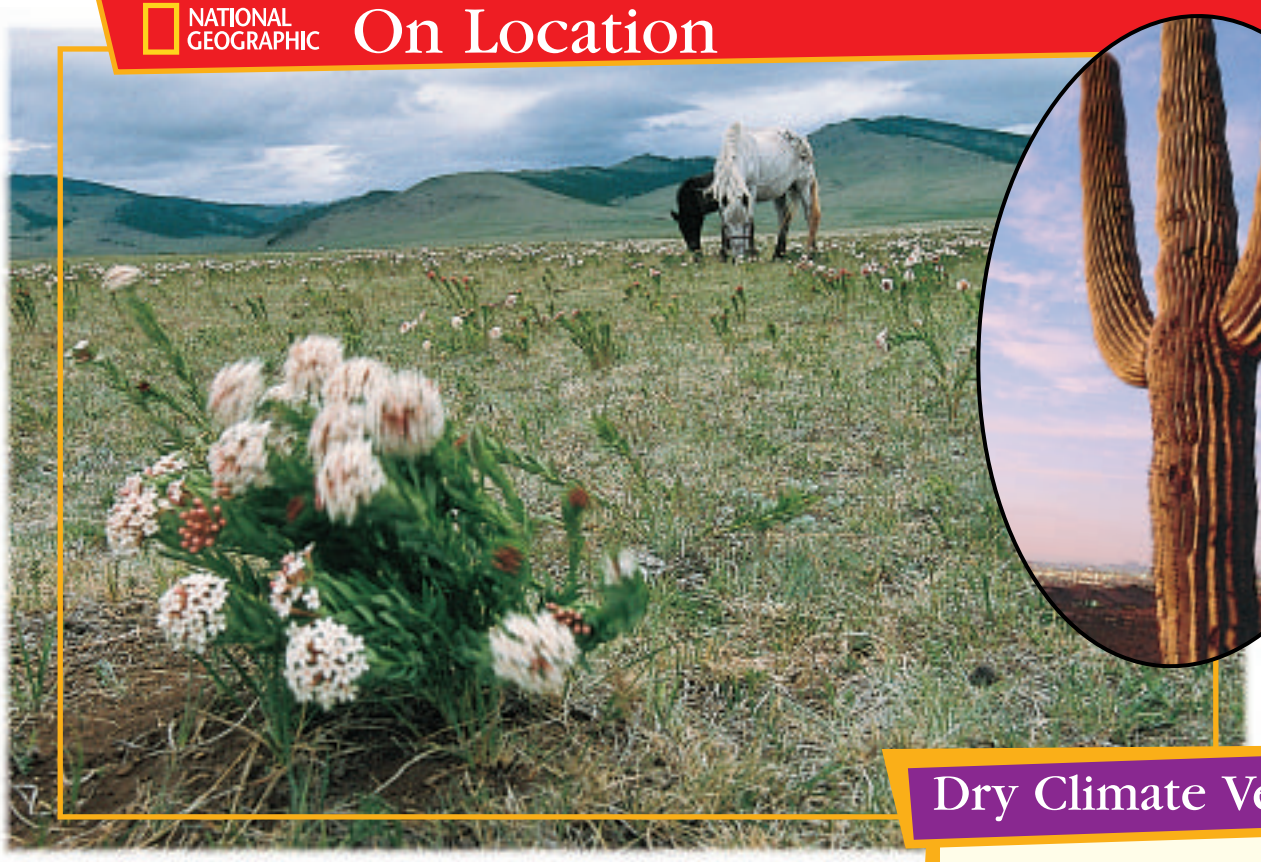
On Location

High Latitude Vegetation

Vegetation in high latitude climates includes **tundra** grasses and bushes (top left), **subarctic** evergreen forests (bottom left), and **ice cap** lichens (background).

Region **How does permafrost affect vegetation in the tundra and subarctic regions?**

NATIONAL GEOGRAPHIC **On Location**



Dry Climate Vegetation

The vegetation that survives **desert** and **steppe** climates includes cacti (above) and short grasses (left).

Region **Are very dry climates always hot? Explain.**

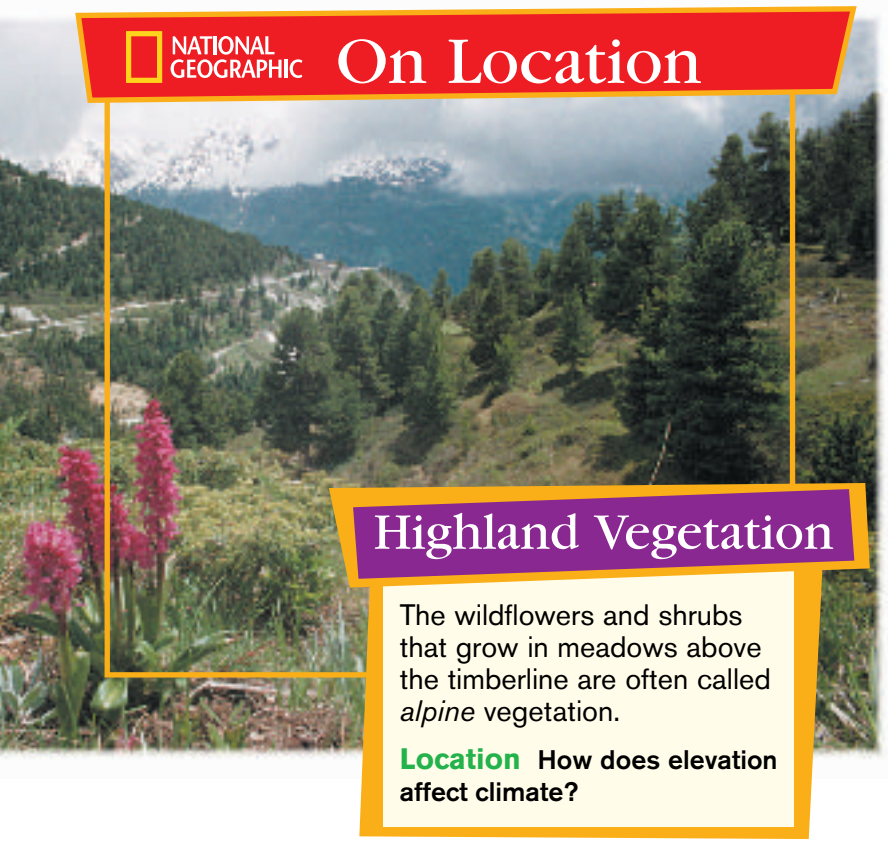
Dry Climates

Dry climates refer to dry or partially dry areas that receive little or no rainfall. Temperatures can be extremely hot during the day and very cold at night. Dry climates can also have severely cold winters. You can find dry climate regions at any latitude.

Desert Climate The driest climates receive less than 10 inches (25 cm) of rainfall per year. Regions with such climates are called deserts. Only scattered plants such as scrub and cacti can survive a desert climate. With roots close to the surface, cacti can collect any rain that falls. Most cacti are found only in North America. In other countries, however, small areas of thick plant life dot the deserts. These arise along rivers or where underground springs reach the surface.

Steppe Climate Many deserts are surrounded by partly dry grasslands and prairies known as **steppes.** The word steppe comes from a Russian word meaning "treeless plain." The steppes receive more rain than deserts, averaging 10 to 20 inches (25 to 51 cm) per year. Bushes and short grasses cover the steppe landscape. The Great Plains of the United States has a steppe climate.

Reading Check **Where are steppe climate zones often located?**



NATIONAL GEOGRAPHIC **On Location**

Highland Vegetation

The wildflowers and shrubs that grow in meadows above the timberline are often called *alpine* vegetation.

Location How does elevation affect climate?

Highland Climate

As you read in Section 2, the elevation of a place changes its climate dramatically. Mountains tend to have cool climates—and the highest mountains have very cold climates. This is true even for mountains that are on the Equator. A highland, or mountain, climate has cool or cold temperatures year-round.

If you climb a mountain, you will reach an area called the timberline. The timberline is the elevation above which no trees grow. Once you reach the timberline, you will find only small shrubs and wildflowers growing in meadows.

Reading Check What is the timberline?

Section 3 Assessment

Defining Terms

1. **Define** savanna, marine west coast climate, Mediterranean climate, humid continental climate, humid subtropical climate, subarctic, tundra, steppe.

Recalling Facts

2. **Region** What are the five types of climate regions?
3. **Region** How do the climate zones in the mid-latitude region differ?
4. **Region** What kind of vegetation grows in the tundra climate zone?

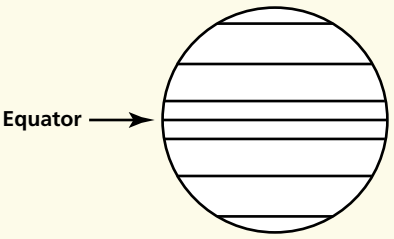
Critical Thinking

5. **Making Comparisons** What do the tropical savanna and humid continental climates have in common?
6. **Drawing Conclusions** How can snow exist in the Tropics along the Equator?

Graphic Organizer

7. **Organizing Information** Draw a globe like this one. Label the three climate regions that are based on latitude, then identify the lines of latitude that separate the climate regions.

Interactive Graphic Organizer



Applying Social Studies Skills

8. **Analyzing Maps** Look at the world natural vegetation regions map on page 64. What type of natural vegetation thrives around Cairo?

Section 4

An Environmental Balance

Guide to Reading

Main Idea

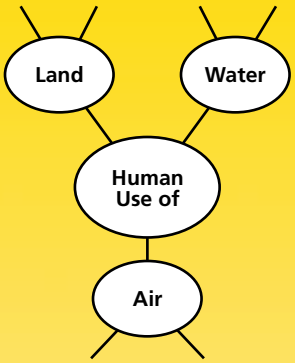
People's actions affect the environment.

Terms to Know

- acid rain
- deforestation
- crop rotation
- conservation
- irrigation
- pesticide
- ecosystem

Reading Strategy

Draw a diagram like this one. Then write at least two problems that arise with human use of water, land, and air.



Interactive Graphic Organizer

NATIONAL GEOGRAPHIC Exploring Our World

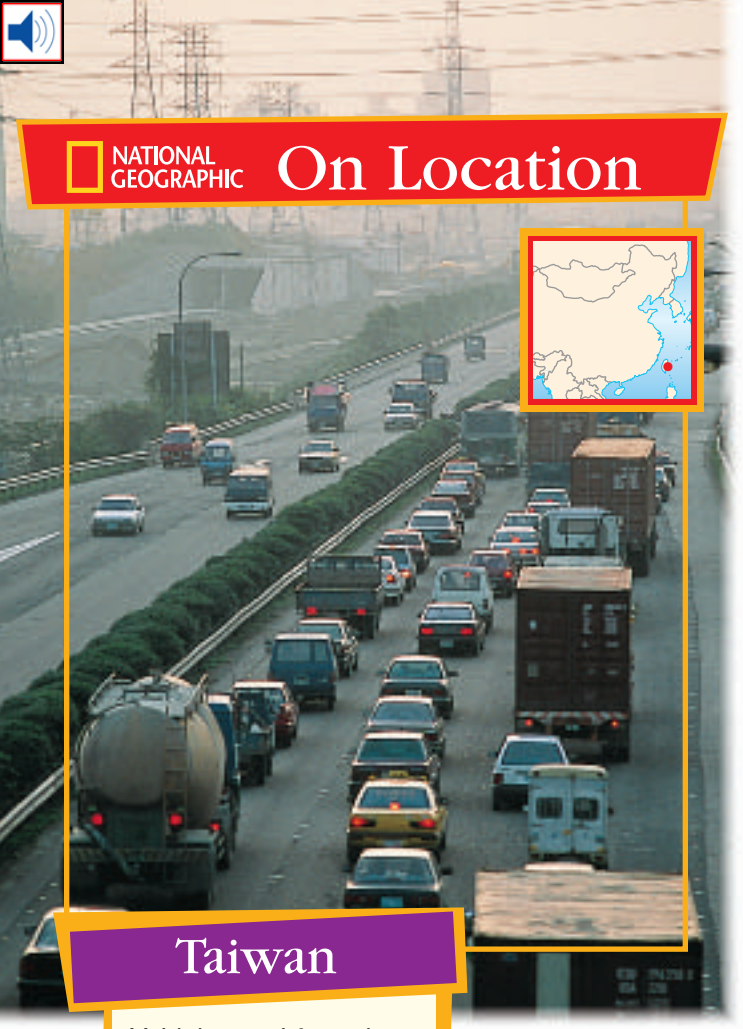
What happens when we harm the environment? Some plants and animals might be gone forever. This scientist hopes to prevent that. She works at a seed bank. Behind her, stored at −4°F (−20°C), are jars of plant seeds from around the world. Should any of these 4,000 types of plants become extinct, these seeds can start growing them again.

Earth's physical geography is made up of four basic parts. The atmosphere, as you read in Chapter 1, is the blanket of gases, or air, surrounding the earth. The lithosphere is the earth's hard outer shell, or what we view as land areas. The hydrosphere includes all the water in the oceans, lakes, rivers, and glaciers, plus all precipitation. Humans are part of the biosphere, which includes all living things and the environments in which they live. A delicate balance exists among these four "spheres." The world's people must act to preserve this balance.

The Atmosphere

Throughout the world, fumes and chemicals from vehicles and industries pollute the air. Air pollution also includes solid particles such as ash and dust. When air pollution is concentrated in urban areas, the air becomes harmful to breathe. Yet air pollution has an even greater effect on the earth as a whole.

NATIONAL GEOGRAPHIC **On Location**



Taiwan

Vehicles and factories add harmful chemicals to the air.

Human/Environment Interaction **What are some effects of air pollution?**

The global effects of air pollution include global warming, ozone depletion, and acid rain. Some scientists believe that increasing amounts of pollutants in the atmosphere have caused the earth to warm. You learned earlier about this greenhouse effect.

Air pollution also affects the ozone layer in the atmosphere. The ozone layer serves as a protective shield as it filters out harmful rays of the sun. Certain chemicals, when they move into the upper atmosphere, destroy ozone molecules. Turn to page 772 to read more about the depletion—and repair—of the earth's "sunscreen."

Chemicals in air pollution can also combine with precipitation, which then falls as **acid rain.** Acid rain kills fish and eats away at the surfaces of buildings. It can even destroy entire forests.

Reading Check **What are two forms of pollutants found in air?**

The Lithosphere

The telephone you use, the microwave that heats your snacks, and the food you eat all come from land resources. Copper, iron, aluminum, and other minerals and ores are mined from the earth. To get to these resources, huge amounts of soil and rock must be removed. This harms the environment. In the United States, mining companies are required to restore the land and replant vegetation when their mining operations are finished.

Topsoil Rich topsoil is a vital part of the lithosphere. If people do not carefully manage the soil, it can be carried away by wind or water. In the Tropics, erosion by water presents a problem—especially if farmers plant their crops on sloping land. When heavy rains come, the soil may simply wash down the hillside. Some farmers have solved this problem by terracing their fields, or planting their crops in a stair-step fashion on slopes.

Deforestation, or cutting down forests without replanting, is another way in which topsoil is lost. When the tree roots are no longer there to hold the soil, wind and water can carry it away.

To enrich their topsoil, many farmers use fertilizers. Some also practice **crop rotation,** or changing what they plant in a field. This avoids using up all the minerals in the soil. Some crops, such as beans, actually restore valuable minerals to the soil. Many farmers now plant bean crops every three years to build up the soil.

Reading Check **How does deforestation lead to erosion?**

The Hydrosphere

People, plants, and most animals need freshwater to live. Remember that only a small fraction of the world's freshwater is unfrozen, however. Since the earth's supply of water is limited, people must learn to manage freshwater carefully.

Water Management Managing water supplies involves two main steps. The first step is **conservation,** or the careful use of resources so they are not wasted. Did you know that 6 or 7 gallons (23 to 27 liters) of water go down the drain every minute that you shower? Taking shorter showers is an easy way to prevent wasting water.

Throughout most areas of the world, farmers use **irrigation,** or the practice of collecting water and distributing it to their crops. In fact, as much as 70 percent of all water used is for farming. Most irrigation methods are wasteful because water often evaporates or seeps into the ground before it reaches crops. Many farmers today, however, are trying to use more efficient practices, such as drip irrigation.

The second step in managing the water supply is to avoid polluting water. Most industrial processes use water. Sometimes those processes result in dangerous chemicals entering the water supply. Farmers who apply fertilizers to their soil may also use **pesticides,** or powerful chemicals that kill crop-destroying insects. These substances help increase food production, but they also seep into rivers and groundwater supplies, polluting the waterways.

Reading Check **How can industry and farming harm the water supply?**

NATIONAL GEOGRAPHIC **On Location**

Madeira Islands

This hillside has been terraced to allow the owner to build a house and plant crops.

Human/Environment Interaction **How would terraced fields help prevent erosion?**

The Biosphere

As the human population increases and people expand their communities, they invade **ecosystems.** These are places where the plants and animals are dependent upon one another and their surroundings for survival. Ecosystems can be found in every climate and vegetation region of the world. For example, some people may want to drain a wetland, or marshy area, to get rid of disease-carrying mosquitoes and to make the soil useful for farming or for building homes. When the area is drained, however, the ecosystem is destroyed. The delicate balance among the wetland's biodiversity—the various insects, reptiles, birds, and water plants—is upset.

People are becoming aware of the need to protect ecosystems, and communities are making increased efforts to do so. Wetlands are now recognized as valuable ecosystems. They are protected from development in the United States. Worldwide concern for rain forest ecosystems also has emerged.

Sometimes, though, protecting the environment for the future seems to clash with feeding people in the present. Remember that people, as well as plants and other animals, are also part of the biosphere. Thus, farmers in the rain forests burn or cut down trees not because they want to, but because they need to feed their families. Before they stop cutting down forests, these farmers will need to find new ways to meet their needs.

Reading Check **How does saving the rain forests clash with current human needs?**

Assessment

Defining Terms

1. **Define** acid rain, deforestation, crop rotation, conservation, irrigation, pesticide, ecosystem.

Recalling Facts

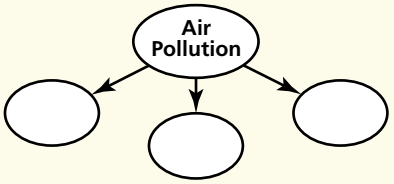
2. **Region** What are the four "spheres" of the earth?
3. **Human/Environment Interaction** What are two ways of managing water?
4. **Economics** Why do farmers practice crop rotation?

Critical Thinking

5. **Understanding Cause and Effect** Why are most irrigation methods inefficient?
6. **Analyzing Information** Which ecosystems were affected by the growth of your community?

Graphic Organizer

7. **Organizing Information** Draw a diagram like this and list three results of air pollution.



Interactive Graphic Organizer

Applying Social Studies Skills

8. **Analyzing Maps** Look at the vegetation map on page 64. In what parts of the world are tropical rain forests located?

Chapter 2

Reading Review

Section 1 The Water Planet

Terms to Know

water vapor
water cycle
evaporation
condensation
precipitation
collection
glacier
groundwater
aquifer

Main Idea

Water is one of the earth's most precious resources.

✓ **Region** Water covers about 70 percent of the earth's surface.

✓ **Movement** Water follows a cycle of evaporation, condensation, precipitation, and collection on and beneath the ground.

✓ **Science** Humans and most animals need freshwater to live. Only a small fraction of the world's water is found in rivers and lakes.

Section 2 Climate

Terms to Know

weather
climate
Tropics
drought
El Niño
La Niña
current
local wind
rain shadow
greenhouse effect
rain forest

Main Idea

Wind and water carry rainfall and the sun's warmth around the world to create different climates.

✓ **Region** Climate is the usual pattern of weather over a long period of time.

✓ **Region** The Tropics, near the Equator, receive more of the sun's warmth than other regions.

✓ **Location** Landforms and position near water affect climate in a local area.

✓ **Culture** Human actions like building cities, burning fuels, and clearing the rain forests can affect climate.

Section 3 Climate Zones and Vegetation

Terms to Know

savanna
marine west coast climate
Mediterranean climate
humid continental climate
humid subtropical climate
subarctic
tundra
steppe

Main Idea

Geographers divide the world into different climate zones.

✓ **Region** The world has five main climate regions that are based on latitude, amount of moisture, and/or elevation. These regions are tropical, mid-latitude, high latitude, dry, and highland.

✓ **Region** Each climate zone has particular kinds of vegetation.

Section 4 An Environmental Balance

Terms to Know

acid rain
deforestation
crop rotation
conservation
irrigation
pesticide
ecosystem

Main Idea

People's actions affect the environment.

✓ **Human/Environment Interaction** A delicate balance exists among the earth's hydrosphere, lithosphere, atmosphere, and biosphere.

✓ **Human/Environment Interaction** People need to carefully manage and conserve water and land resources.

Chapter 2 Assessment and Activities

Using Key Terms

Match the terms in Part A with their definitions in Part B.

A.

1. evaporation
2. savanna
3. crop rotation
4. tundra
5. condensation
6. greenhouse effect
7. rain forest
8. El Niño
9. precipitation
10. current

B.

a. moving streams of water in the oceans
b. treeless plain in which only the top few inches of ground thaw in summer
c. weather pattern in the Pacific Ocean
d. alternating what is planted in a field
e. buildup of certain gases in the atmosphere that holds the sun's warmth
f. water that falls back to the earth
g. dense forest that receives much rain
h. water vapor changes back into a liquid
i. sun's heat turns water into water vapor
j. broad grassland in the Tropics

Reviewing the Main Ideas

Section 1 The Water Planet

11. **Movement** What are the four steps in the water cycle?
12. **Region** What percentage of the world's water is freshwater?
13. **Region** Which has more freshwater—lakes and rivers or groundwater?

Section 2 Climate

14. **Movement** How do wind and water affect climate?
15. **Location** How do mountains affect rainfall?
16. **Human/Environment Interaction** Why are cities warmer than nearby rural areas?

Section 3 Climate Zones and Vegetation

17. **Region** Which climate region has the most climate zones? Why?
18. **Place** What kind of vegetation grows in Mediterranean climates?

Section 4 An Environmental Balance

19. **Human/Environment Interaction** How can farmers restore the minerals in the soil?
20. **Region** What makes up a wetlands biodiversity?

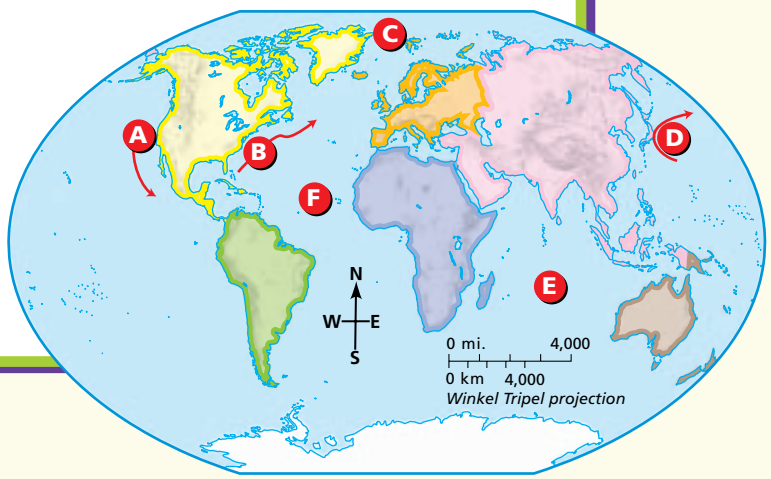
NATIONAL GEOGRAPHIC

World Oceans and Currents

Place Location Activity

On a separate sheet of paper, match the letters on the map with the numbered places listed below.

1. Arctic Ocean
2. Atlantic Ocean
3. California Current
4. Japan Current
5. Indian Ocean
6. Gulf Stream



CONTENTS

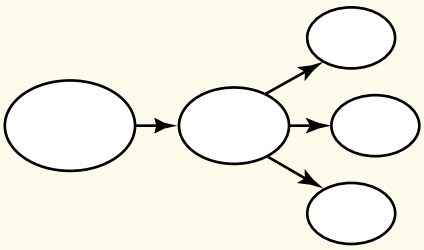
Social Studies ONline

Self-Check Quiz Visit ***The World and Its People*** Web site at twip.glencoe.com and click on **Chapter 2—Self-Check Quizzes** to prepare for the Chapter Test.

Critical Thinking

21. **Analyzing Information** From where does the freshwater in your community come? How can you find out?

22. **Categorizing Information** Create five webs like the one shown here. In each large oval, write the name of a climate region. In the medium-sized ovals, write the name of each climate zone in that region. For each zone, fill in the three small ovals with the usual weather in summer, the usual weather in winter, and the kind of vegetation.



Comparing Regions Activity

23. **Culture** As you have learned, a region's climate helps determine how people live. Flip through your textbook or a geographic magazine to find pictures of people in their environments. What can you infer about their climates?

Mental Mapping Activity

24. **Focusing on the Region** Draw a freehand map of the world's oceans and continents. Label the following items:

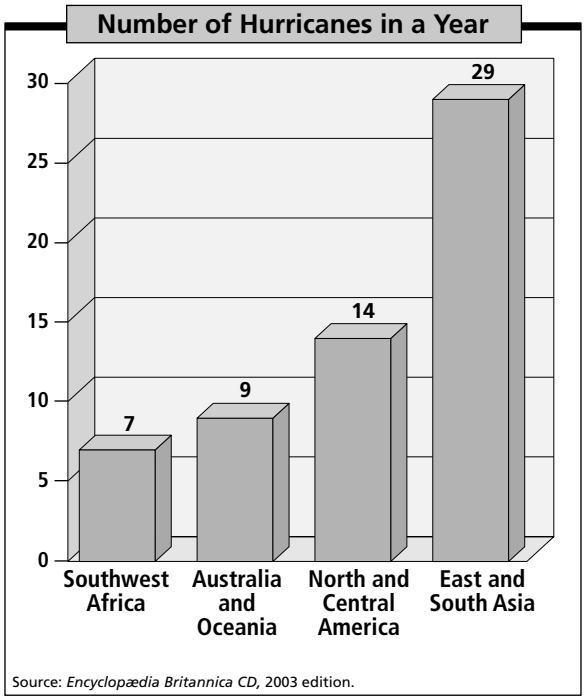
- Equator
- Pacific Ocean
- high latitude climate regions
- tropical climate regions
- North America
- Africa

Technology Skills Activity

25. **Using the Internet** Research a recent hurricane or tornado. Find out when and where it occurred, how much force the storm had, and what damage it caused.

Standardized Test Practice

Directions: Study the graph below, and then answer the question that follows.



Source: *Encyclopædia Britannica CD*, 2003 edition.

1. How many more hurricanes do East and South Asia experience in a year than North and Central America?

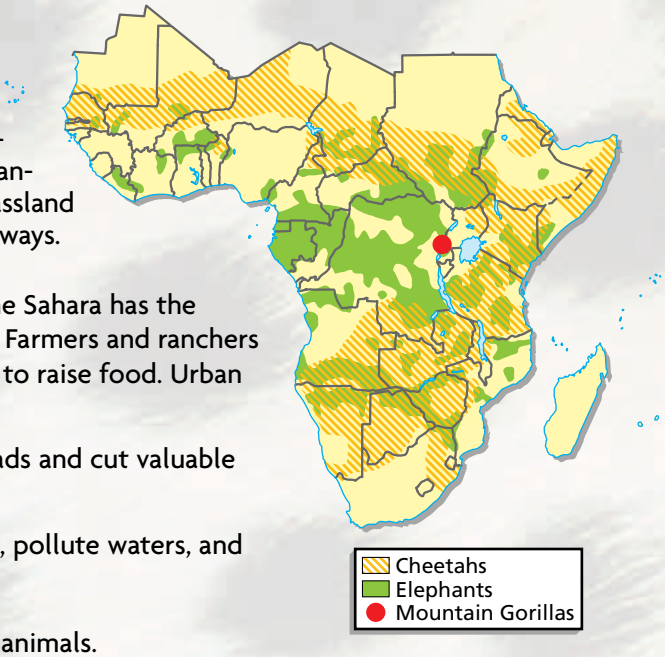
F 29
G 14
H 9
J 15

Test-Taking Tip: Make sure you read the question carefully. It is not asking for the total number of hurricanes in East and South Asia. Instead, the question asks how many *more* hurricanes one region has than another.

EYE on the Environment

Endangered Spaces

Shrinking Habitats When you think of Africa, what images come to mind? Roaring lions? Sprinting cheetahs? Lumbering elephants? Unless conditions change, some wild African animals may soon be only memories. Many are endangered, primarily because their habitats—their grassland and forest homes—are being destroyed in many ways.



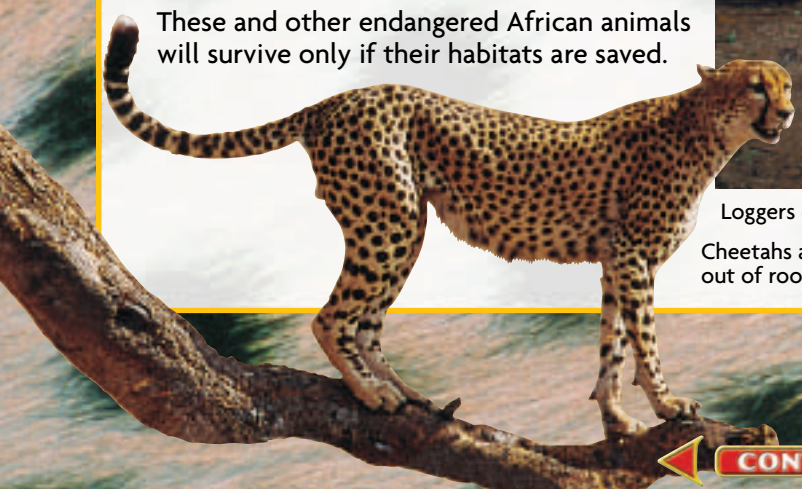
- Population growth — Africa south of the Sahara has the world's highest population growth rate. Farmers and ranchers turn wild lands into fields and pastures to raise food. Urban sprawl also takes over habitats.
- Logging — Logging companies build roads and cut valuable trees, destroying forest habitats.
- Mining — Open pit mines scar the land, pollute waters, and destroy trees.

As habitats shrink, so do populations of African animals.

- Cheetahs live in Africa's grasslands. As people move into the cheetahs' home, the big cats struggle to survive. Only about 12,000 cheetahs are left in the wild.
- Mountain gorillas live in the misty mountain forests of Central and East Africa. Logging and mining are destroying these forests. Only about 650 mountain gorillas remain.

These and other endangered African animals will survive only if their habitats are saved.

Loggers destroy a forest in the Democratic Republic of the Congo.



Cheetahs are running out of room in Africa.

NATIONAL GEOGRAPHIC

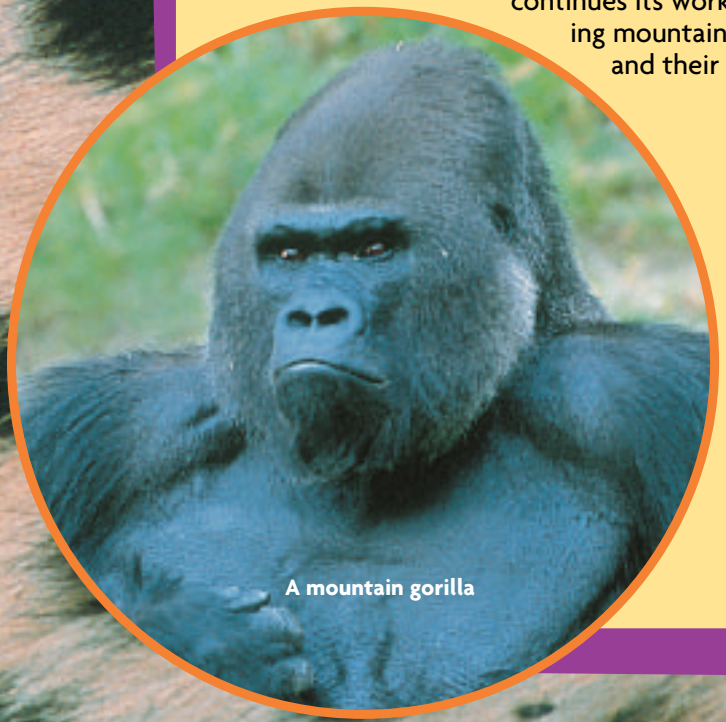
Making a Difference

The Cheetah Conservation Fund Cheetahs in Africa are getting a helping hand from the Cheetah Conservation Fund (CCF). This organization is based in Namibia, which is home to about 2,500 cheetahs. Namibian ranchers often trap and shoot cheetahs to protect their livestock. The CCF has donated about 80 special herding dogs to ranchers. The dogs protect the livestock and keep cheetahs out of harm's way at the same time. The CCF also teaches villagers and schoolchildren about cheetahs and about why it is important to save these big cats and their habitats.

Namibian children learn about cheetahs.

Protecting Gorillas For nearly 20 years, Dian Fossey studied mountain gorillas in Rwanda. Through her book, *Gorillas in the Mist*, which was made into a movie, Fossey told others about mountain gorillas and how their survival was threatened by habitat destruction and poaching. Fossey established the Karisoke Research Center and an international fund to support gorilla conservation.

Dian Fossey fought fiercely to end gorilla poaching. Although Fossey was murdered at Karisoke in 1985, the Dian Fossey Gorilla Fund International continues its work protecting mountain gorillas and their habitat.


A mountain gorilla

What Can You Do?

Adopt a Cheetah

You and your classmates can help save cheetahs in the wild by adopting one. To learn more, contact the Cheetah Conservation Fund at www.cheetah.org

Find Out More

What animal habitats are endangered where you live? Work with a partner to investigate endangered spaces in your area. Summarize your findings in a report to the class.