SECTION 1

Weather and Climate

What You Will Learn...

Main Ideas

1. While weather is short term, climate is a region's average weather over a long period.
2. The amount of sun at a given location is affected by Earth's tilt, movement, and shape.
3. Wind and water move heat around Earth, affecting how warm or wet a place is.
4. Mountains influence temperature and precipitation.

The Big Idea

The sun, location, wind, water, and mountains affect weather and climate.

Key Terms

weather, *p. 50*
climate, *p. 50*
prevailing winds, *p. 51*
ocean currents, *p. 52*
front, *p. 53*

TAKING NOTES As you read, use a chart like the one here to take notes about the factors that affect weather and climate.

Sun and Location	Wind and Water	Mountains

If YOU lived there...

You live in Buffalo, New York, at the eastern end of Lake Erie. One evening in January, you are watching the local TV news. The weather forecaster says, "A huge storm is brewing in the Midwest and moving east. As usual, winds from this storm will drop several feet of snow on Buffalo as they blow off Lake Erie."

Why will winds off the lake drop snow on Buffalo?

BUILDING BACKGROUND All life on Earth depends on the sun's energy and on the cycle of water from the land to the air and back again. In addition, sun and water work with other forces, such as wind, to create global patterns of weather and climate.

Understanding Weather and Climate

"Climate is what you expect; weather is what you get."
—Robert Heinlein, from *Time Enough for Love*

What is it like outside right now where you live? Is it hot, sunny, wet, cold? Is this what it is usually like outside for this time of year? The first two questions are about **weather**, the short-term changes in the air for a given place and time. The last question is about **climate**, a region's average weather conditions over a long period.

Weather is the temperature and precipitation from hour to hour or day to day. "Today is sunny, but tomorrow it might rain," is a statement about weather. Climate is the expected weather for a place based on data and experience. "Summer here is usually hot and muggy," is a statement about climate. The factors that shape weather and climate include the sun, location on Earth, wind, water, and mountains.

READING CHECK **Finding Main Ideas** How are weather and climate different from each other?

Sun and Location

Energy from the sun heats the planet. Different locations receive different amounts of sunlight, though. Thus, some locations are warmer than others. The differences are due to Earth's tilt, movement, and shape.

You have learned that Earth is tilted on its axis. The part of Earth tilted toward the sun receives more solar energy than the part tilted away from the sun. As the Earth revolves around the sun, the part of Earth that is tilted toward the sun changes during the year. This process creates the seasons. In general, temperatures in summer are warmer than in winter.

Earth's shape also affects the amount of sunlight different locations receive. Look at the diagram of Earth at right. You can see that Earth is a sphere, or wider in the middle. For this reason, the sun's rays directly strike the equator but only somewhat strike the poles.

As a result, areas near the equator, called the lower latitudes, are mainly hot year-round. Areas near the poles, called the higher latitudes, are cold year-round. Areas about halfway between the equator and poles have more seasonal change. In general, the farther from the equator, or the higher the latitude, the colder the climate.

READING CHECK **Summarizing** How does Earth's tilt on its axis affect climate?

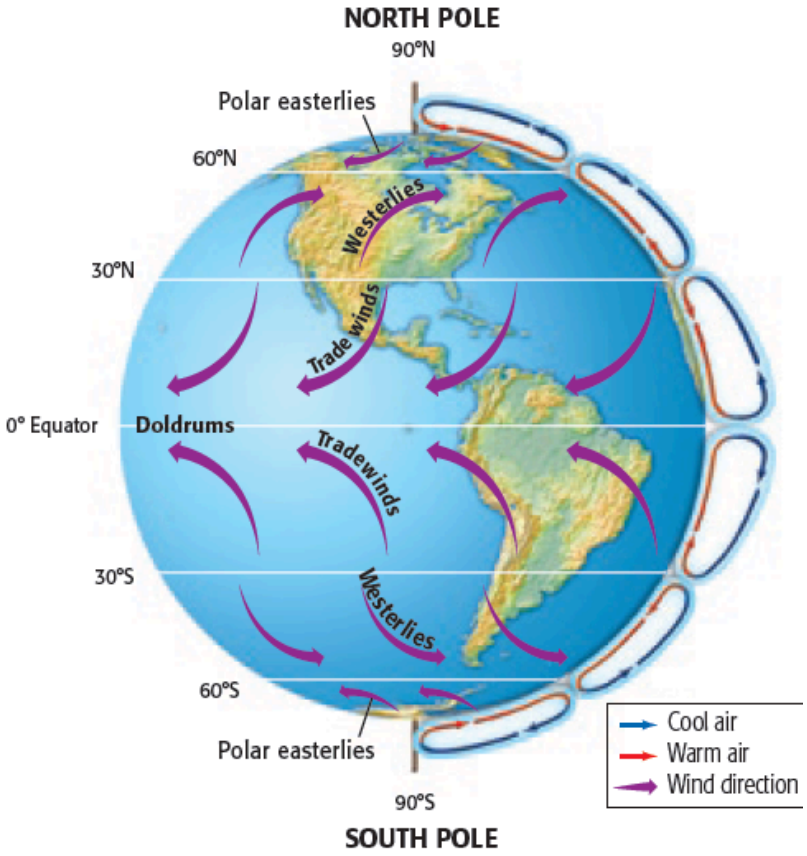
Wind and Water

Heat from the sun moves across Earth's surface. The reason is that air and water warmed by the sun are constantly on the move. You might have seen a gust of wind or a stream of water carrying dust or dirt. In a similar way, wind and water carry heat from place to place. As a result, they make different areas of Earth warmer or cooler.

Global Wind Systems

Prevailing winds blow in circular belts across Earth. These belts occur at about every 30° of latitude.

ANALYZING VISUALS **Which direction do the prevailing winds blow across the United States?**

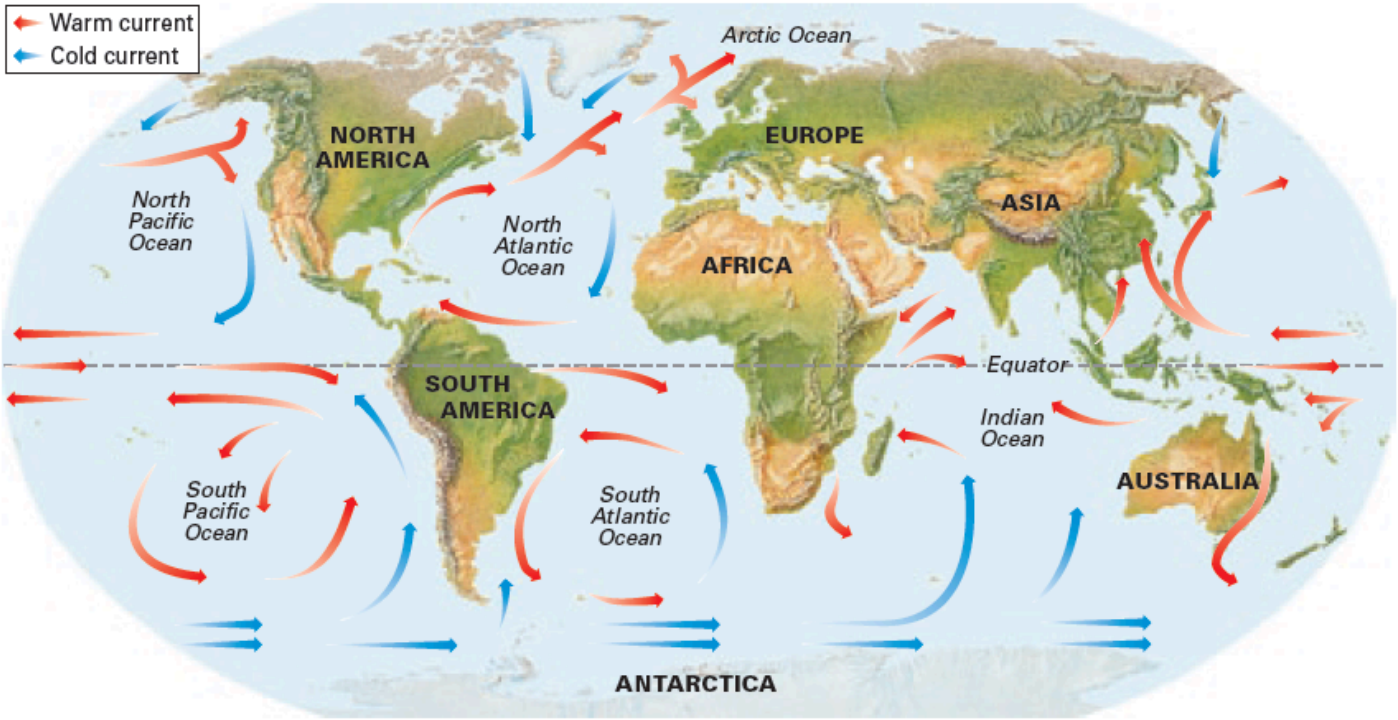


Global Winds

Wind, or the sideways movement of air, blows in great streams around the planet. **Prevailing winds** are winds that blow in the same direction over large areas of Earth. The diagram above shows the patterns of Earth's prevailing winds.

To understand Earth's wind patterns, you need to think about the weight of air. Although you cannot feel it, air has weight. This weight changes with the temperature. Cold air is heavier than warm air. For this reason, when air cools, it gets heavier and sinks. When air warms, it gets lighter and rises. As warm air rises, cooler air moves in to take its place, creating wind.

Major Ocean Currents



map zone Geography Skills

Movement Ocean currents carry warm water from the equator toward the poles and cold water from the poles toward the equator. The currents affect temperature.

1. **Use the Map** Does a warm or cold ocean current flow along the lower west coast of North America?
2. **Explain** How do ocean currents move heat between warmer and colder areas of Earth?

On a global scale, this rising, sinking, and flowing of air creates Earth's prevailing wind patterns. At the equator, hot air rises and flows toward the poles. At the poles, cold air sinks and flows toward the equator. Meanwhile, Earth is rotating. Earth's rotation causes prevailing winds to curve east or west rather than flowing directly north or south.

FOCUS ON READING
What is the effect of Earth's rotation on prevailing winds?

Depending on their source, prevailing winds make a region warmer or colder. In addition, the source of the winds can make a region drier or wetter. Winds that form from warm air or pass over lots of water often carry moisture. In contrast, winds that form from cold air or pass over lots of land often are dry.

Ocean Currents

Like wind, **ocean currents**—large streams of surface seawater—move heat around Earth. Winds drive these currents. The map above shows how Earth's ocean currents carry warm or cool water to different areas. The water's temperature affects air temperature near it. Warm currents raise temperatures; cold currents lower them.

The Gulf Stream is a warm current that flows north along the U.S. East Coast. It then flows east across the Atlantic to become the North Atlantic Drift. As the warm current flows along northwestern Europe, it heats the air. Westerlies blow the warmed air across Europe. This process makes Europe warmer than it otherwise would be.

Large Bodies of Water

Large bodies of water, such as an ocean or sea, also affect climate. Water heats and cools more slowly than land does. For this reason, large bodies of water make the temperature of the land nearby milder. Thus, coastal areas, such as the California coast, usually do not have as wide temperature ranges as inland areas.

As an example, the state of Michigan is largely surrounded by the Great Lakes. The lakes make temperatures in the state milder than other places as far north.

Wind, Water, and Storms

If you watch weather reports, you will hear about storms moving across the United States. Tracking storms is important to us because the United States has so many of them. As you will see, some areas of the world have more storms than others do.

Most storms occur when two air masses collide. An air mass is a large body of air. The place where two air masses of different temperatures or moisture content meet is a **front**. Air masses frequently collide in regions like the United States, where the westerlies meet the polar easterlies.

Fronts can produce rain or snow as well as severe weather such as thunderstorms and icy blizzards. Thunderstorms produce rain, lightning, and thunder. In the United States, they are most common in spring and summer. Blizzards produce strong winds and large amounts of snow and are most common during winter.

Thunderstorms and blizzards can also produce tornadoes, another type of severe storm. A tornado is a small, rapidly twisting funnel of air that touches the ground. Tornadoes usually affect a limited area and last only a few minutes. However, they can be highly destructive, uprooting trees and tossing large vehicles through the air. Tornadoes can be extremely deadly as well. In 1925 a tornado that crossed Missouri, Illinois, and Indiana left 695 people dead. It is the deadliest U.S. tornado on record.

The largest and most destructive storms, however, are hurricanes. These large, rotating storms form over tropical waters in the Atlantic Ocean, usually from late summer to fall. Did you know that hurricanes and typhoons are the same? Typhoons are just hurricanes that form in the Pacific Ocean.

Extreme Weather

Severe weather is often dangerous and destructive. In the top photo, rescuers search for people during a flood in Yardley, Pennsylvania. Below, a tornado races across a wheat field.

Rain Shadow Effect

Most of the moisture in the ocean air falls on the mountainside facing the wind. LIttle moisture remains to fall on the other side, creating a rain shadow.

Hurricanes produce drenching rain and strong winds that can reach speeds of 155 miles per hour (250 kph) or more. This is more than twice as fast as most people drive on highways. In addition, hurricanes form tall walls of water called storm surges. When a storm surge smashes into land, it can wipe out an entire coastal area.

READING CHECK **Analyzing** Why do coastal areas have milder climates than inland areas?

Mountains

Mountains can influence an area's climate by affecting both temperature and precipitation. Many high mountains are located in warm areas yet have snow at the top all year. How can this be? The reason is that temperature decreases with elevation—the height on Earth's surface above sea level.

Mountains also create wet and dry areas. Look at the diagram at left. A mountain forces air blowing against it to rise. As it rises, the air cools and precipitation falls as rain or snow. Thus, the side of the mountain facing the wind is often green and lush. However, little moisture remains for the other side. This effect creates a rain shadow, a dry area on the mountainside facing away from the direction of the wind.

READING CHECK **Finding Main Ideas** How does temperature change with elevation?

SUMMARY AND PREVIEW As you can see, the sun, location on Earth, wind, water, and mountains affect weather and climate. In the next section you will learn what the world's different climate regions are like.

Section 1 Assessment

go.hrw.com
Online Quiz
KEYWORD: SK7 HP3

Reviewing Ideas, Terms, and Places

1. a. **Recall** What shapes **weather** and **climate**?
   b. **Contrast** How do weather and climate differ?
2. a. **Identify** What parts of Earth receive the most heat from the sun?
   b. **Explain** Why do the poles receive less solar energy than the equator does?
3. a. **Describe** What creates wind?
   b. **Summarize** How do **ocean currents** and large bodies of water affect climate?
4. a. **Define** What is a rain shadow?
   b. **Explain** Why might a mountaintop and a nearby valley have widely different temperatures?

Critical Thinking

5. **Identifying Cause and Effect** Draw a chart like this one. Use your notes to explain how each factor affects climate.

	Effect on Climate
Sun and Location →	
Wind →	
Water →	
Mountains →	

FOCUS ON VIEWING

6. **Writing about Weather and Climate** Jot down information to include in your weather report. For example, you might want to include a term such as *fronts* or describe certain types of storms such as hurricanes or tornadoes.