

Section 3

What Is Climate?

Key Concept Earth's climate zones are caused by the distribution of heat around Earth's surface by wind and ocean currents.

What You Will Learn

- Climate is the average weather condition in an area over a long period of time.
- Climate is affected by latitude, global winds, topography, proximity to large bodies of water, and ocean currents.

Why It Matters

Climate and seasonal weather patterns determine where people can live on Earth.

Suppose that you receive a call from a friend who is coming to visit you tomorrow. To decide what clothing to bring, he asks about the current weather in your area.

You step outside to see if rain clouds are in the sky and to check the temperature. But what would you do if your friend asked you about the climate in your area? What is the difference between weather and climate?

Climate Versus Weather

The major difference between weather and climate is the length of time over which the conditions are measured. *Weather* is the condition of the atmosphere at a certain time. Weather conditions change from day to day. **Climate**, on the other hand, describes the average weather conditions in an area over a long period of time. Climate is usually described by using two factors—temperature and amount of precipitation. Different parts of the world have different climates, as shown in **Figure 1**. But why are climates so different?



Figure 1 North America has a variety of climates. **How does the climate where you live compare to the climate in northern Africa?**

Standards Check Name two factors that are used to describe climate.

□

Factors That Affect Climate

For the most part, climate is determined by temperature and precipitation. But what factors affect the temperature and precipitation rates of an area? Those factors include latitude, wind patterns, locations of mountains and large bodies of water, and nearness to ocean currents.

Solar Energy and Latitude

If you look at a globe, you will see horizontal lines that circle the globe. Those lines are called lines of latitude. **Latitude** is the distance north or south from the equator. In general, the temperature of an area depends on its latitude. The higher the latitude is, the colder the climate tends to be. One of the coldest places on Earth, the North Pole, is 90° north of the equator. However, the equator, at latitude 0° , is usually hot.

Latitude affects the temperature of an area because latitude determines the amount of direct solar energy a certain area receives. **Figure 2** shows how the curve of Earth affects the amount of direct solar energy at different latitudes. Notice that the sun's rays travel in a line parallel to one another. The sun's rays hit the equator directly, at almost a 90° angle. At this angle, the solar energy is concentrated on a small area of Earth's surface. That small area receives the maximum amount of solar energy. As a result, that area has high temperatures.

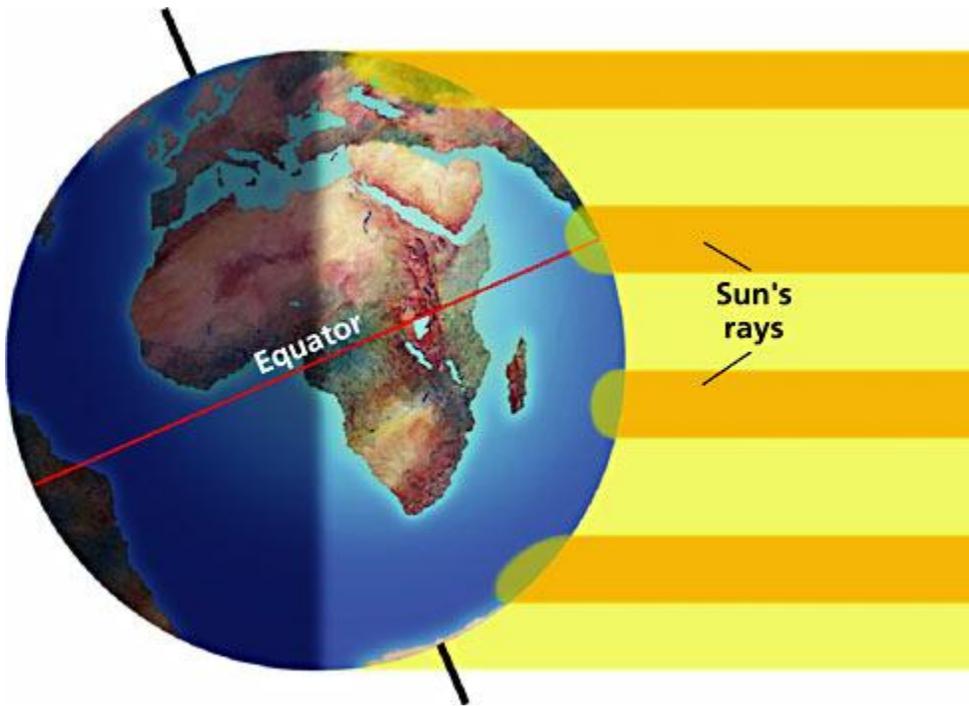
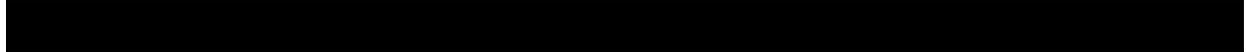


Figure 2 The sun's rays strike Earth's surface at different angles because Earth's surface is curved.

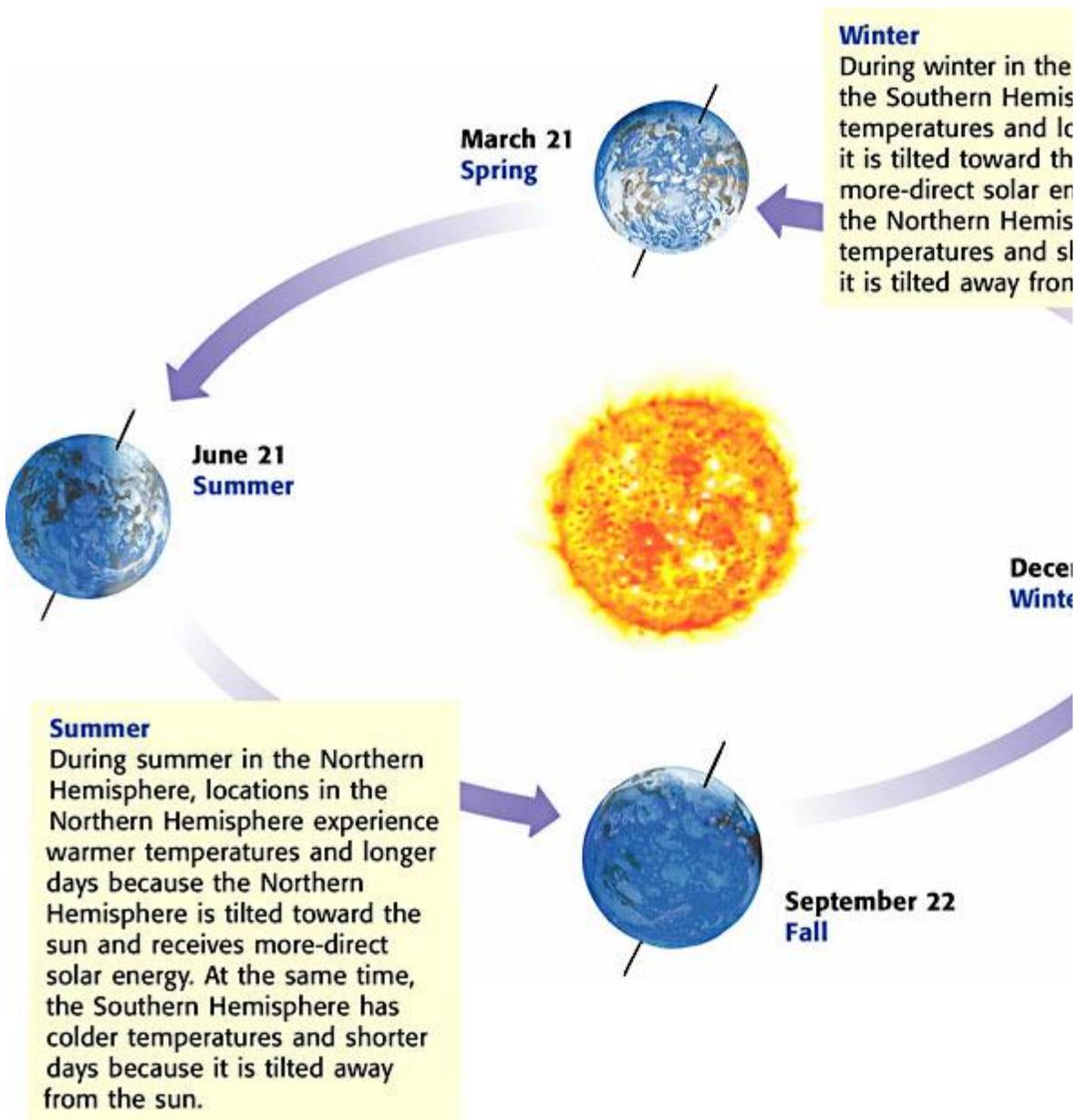
At the poles, the sun's rays strike at a lesser angle than they do at the equator. At this angle, the same amount of solar energy that hits the area at the equator is spread over a larger area at the poles. Because the energy is less concentrated, the poles have lower temperatures than the equator.



Latitude and Seasons

In most places in the United States, the year has four seasons. But there are places in the world that do not have such seasonal changes. Places near the equator have about the same temperatures and same amount of daylight year-round. Seasons happen because Earth is tilted on its axis at a 23.5° angle. This tilt affects how much solar energy an area receives as Earth moves around the sun. **Figure 3** shows how latitude and the tilt of Earth determine the seasons and the length of the day in a particular area.

Figure 3 The Seasons



Standards Check Why do some places on Earth have seasons?

□



Global Circulation and Winds

Wind moves in predictable patterns across Earth's surface. The patterns of winds are the result of convection currents caused by uneven heating of Earth's surface. This uneven heating forms areas of different air pressure. Wind blows from areas of higher pressure to areas of lower pressure. The major wind belts on Earth's surface are shown in **Figure 4**.

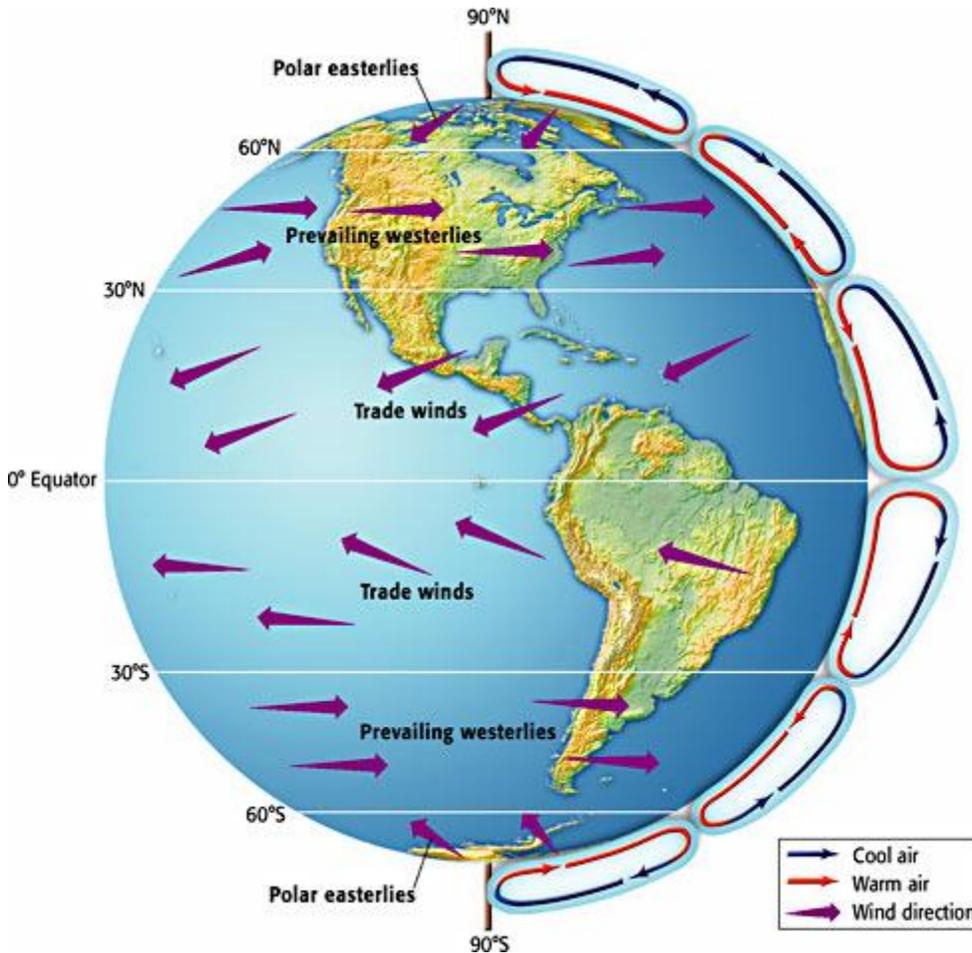


Figure 4 Both the Northern Hemisphere and the Southern Hemisphere have three wind belts as a result of differences in air pressure.

The speed and direction, as well as the temperature and moisture content, of winds affect climate and weather. Winds carry solar energy to and from different locations, so the temperature of both locations changes. Winds also affect the amount of precipitation that a region receives. Winds may carry evaporated water away from the ocean

surface. The water vapor is then carried to other places where it may condense and fall as precipitation.

Standards Check How do winds affect the climate of an area?



Topography

The sizes and shapes of the land-surface features of a region combine to form *topography*. Topography can influence the wind patterns and the transfer of energy in an area. So, topography influences an area's climate by affecting both temperature and precipitation. For example, temperatures in mountainous areas are affected by elevation. **Elevation** is the height of surface landforms above sea level. At high elevations, the temperature of the air is lower. Therefore, as elevation increases, temperature decreases.

Mountains also affect the distribution of precipitation. As air rises to pass over a mountain, the air cools. As a result, clouds form and precipitation may fall. This process causes what is called a *rain-shadow effect*. **Figure 5** shows how a rain shadow affects the climates on two sides of a mountain.

Figure 5 How Mountains Affect Climate

The Wet Side

Mountains force air to rise. The air cools as it rises, releasing moisture as snow or rain. The land on the windward side of the mountain is usually green and lush because the air releases its moisture.

The Dry Side

After dry air crosses the mountain, the air begins to sink. As the air sinks, it becomes warmer and absorbs moisture. This process results in dry climates that may cause desert climates.



Proximity to Large Bodies of Water

Large bodies of water, such as the ocean, can influence an area's climate. Water absorbs and releases heat more slowly than land does. Because of this quality, water

helps moderate the temperature of nearby land. Sudden or extreme temperature changes rarely take place on land near large bodies of water.

The state of Michigan, which is surrounded by the Great Lakes, has more-moderate temperatures than other places at the same latitude. California's climate is also influenced by a large body of water—the ocean. The ocean keeps temperatures in California moderate. Other states that are inland but are at the same latitude as California have wide ranges in temperature.

Ocean Currents

The circulation of ocean surface currents has a large effect on an area's climate.

Surface currents are streamlike movements of water at or near the surface of the ocean, as shown in **Figure 6**. As surface currents move, they carry warm or cool water to different locations. The surface temperature of the water affects the temperature of the air above it. Warm currents heat the surrounding air and cause warmer air temperatures. Cool currents absorb energy from the surrounding air and cause cooler air temperatures. California's climate is affected by a cool ocean current. Cold water from the northern Pacific Ocean is carried south to Mexico by the California current. This current keeps temperatures along the West Coast cooler than inland temperatures all year long.

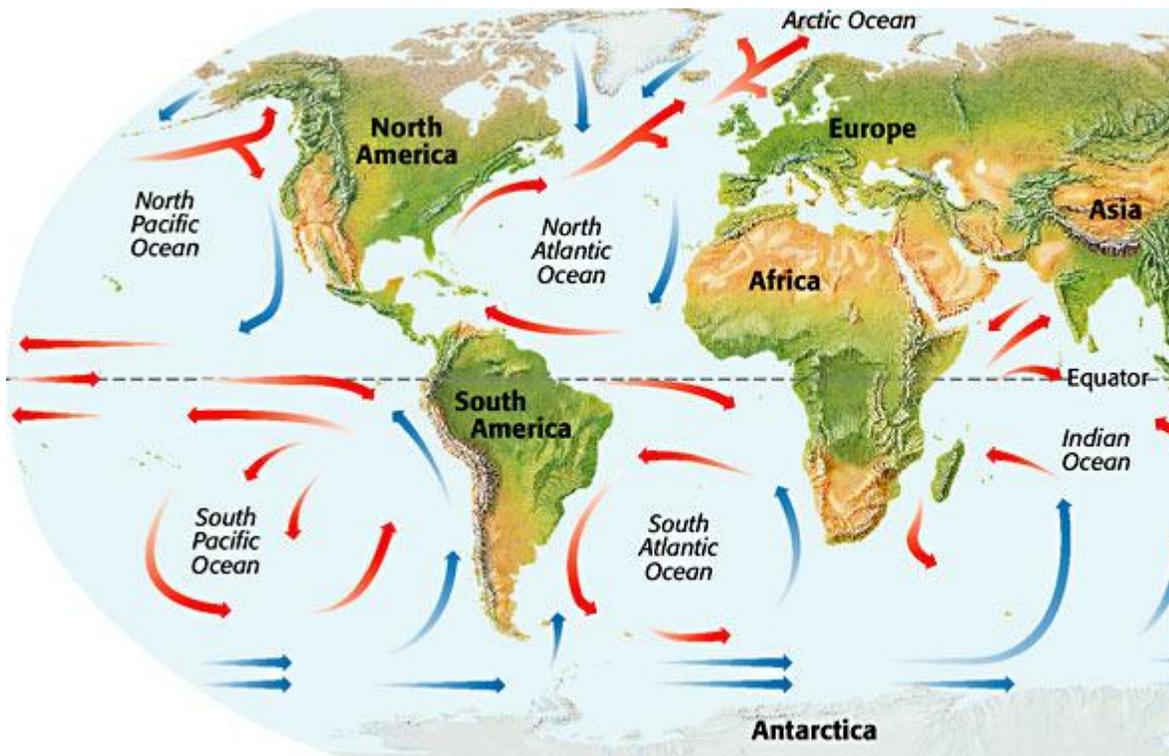


Figure 6 The red arrows represent the movement of warm surface currents. The blue arrows represent the movement of cold surface currents.

Climates of the World

Have you seen any polar bears in your neighborhood lately? You probably have not because polar bears live only in very cold arctic regions. Why are the animals in one part of the world so different from the animals in other parts? One of the differences has to do with climate. Plants and animals that are adapted to one climate may not be able to live in another climate. For example, frogs would not be able to live at the North Pole.

Climate Zones

Earth has three major climate zones—tropical, temperate, and polar. These zones are shown in **Figure 7**. Each zone has a temperature range that relates to its latitude. The tropical zone is characterized by high temperatures and is located in the equatorial region. The temperate zone is characterized by lower temperatures than the tropical zone. It is located between the tropical zone and the polar zone. The polar zone, at latitudes of 66.5° and higher, is the coldest climate zone.

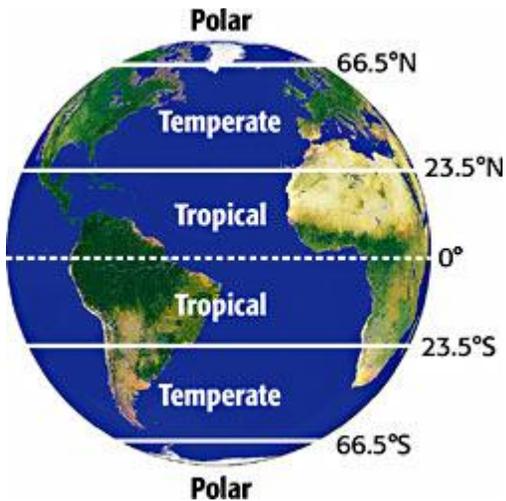
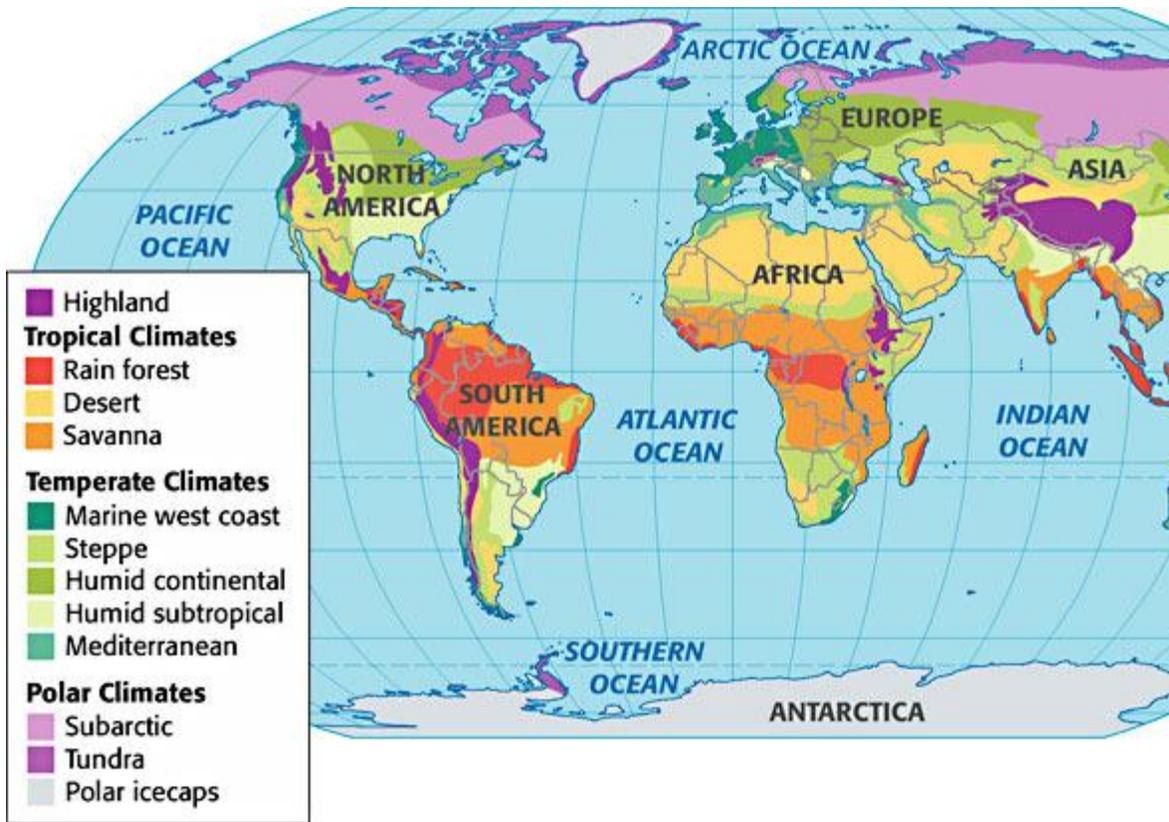


Figure 7 The three major climate zones are determined by latitude.

In each of these zones, there are several kinds of climates. These different climates result from differences in topography, winds, ocean currents, and geography. **Figure 8**

shows the distribution of Earth's climates.

Figure 8 Earth's Climates



Section Summary

- Climate is the average weather conditions in an area over a long period of time.
- The curve of Earth's surface affects the amount of direct solar energy that reaches the ground at different latitudes.
- The tilt of Earth on its axis causes the seasons.
- Winds affect the climate of an area by transferring solar energy and by carrying moisture.

- Topography influences an area's climate by affecting both the transfer of energy and the rate of precipitation.
- Large bodies of water and ocean currents influence the climate of an area by affecting the temperature of the air.
- The three main climate zones of the world are the tropical zone, the temperate zone, and the polar zone.

