

# What Is Climate?

## Terms to Learn

weather	prevailing winds
climate	elevation
latitude	surface currents

## What You'll Do

- ◆ Explain the difference between weather and climate.
- ◆ Identify the factors that determine climates.

You have just received a call from a friend who is coming to visit you tomorrow. He is wondering what clothing to bring and wants to know about the current weather in your area. You step outside, check to see if there are rain clouds in the sky, and note the temperature. But what if your friend asked you about the climate in your area? What is the difference between weather and climate?

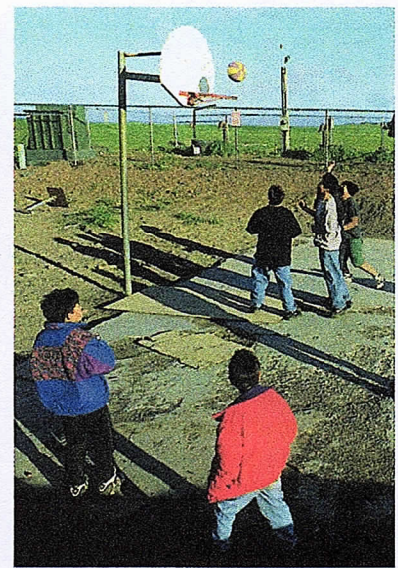
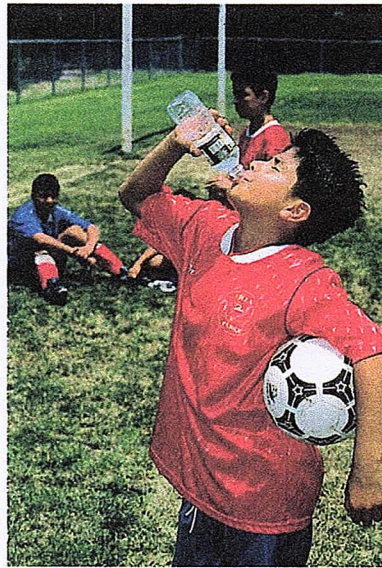
The main difference between weather and climate has to do with time. **Weather** is the condition of the atmosphere at a particular time and place. Weather conditions vary from day to day. **Climate**, on the other hand, is the average weather conditions in an area over a long period of time. Climate is determined by two main factors, temperature and precipitation. Study the map in **Figure 1**, and see if you can describe the climate in northern Africa.

**Figure 1** How does the climate in northern Africa differ from the climate where you live?





As you can see in **Figure 2**, if you were to take a trip around the world, or even across the United States, you would experience different climates. For example, if you visited the Texas coast in the summer, you would find it hot and humid. But if you visited interior Alaska during the summer, it would probably be much cooler and less humid. Why are the climates so different? The answer is complicated. It includes factors such as latitude, wind patterns, geography, and ocean currents.

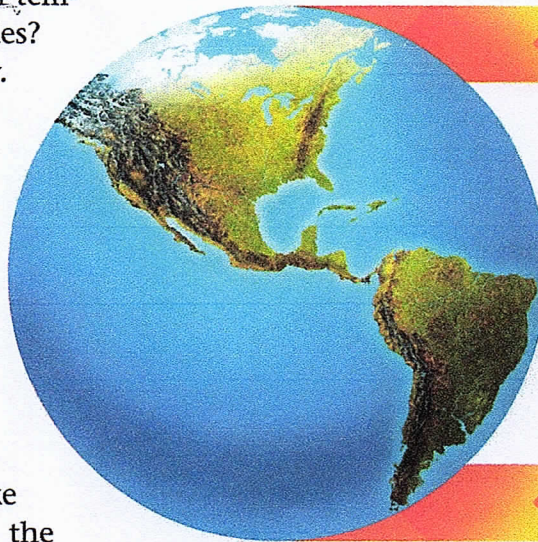


**Figure 2** Summer in Texas is different from summer in Alaska.

## Latitude

Think of the last time you looked at a globe. Do you recall the thin horizontal lines that circle the globe? These horizontal lines are called lines of latitude. **Latitude** is the distance north or south, measured in degrees, from the equator. In general, the temperature of an area depends on its latitude. The higher the latitude is, the colder the climate is. For example, one of the coldest places on Earth, the North Pole, is at  $90^\circ$  north of the equator. On the other hand, the equator, which has a latitude of  $0^\circ$ , is hot.

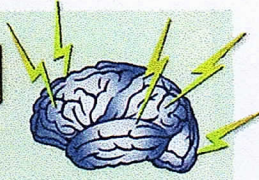
**It's Hot! It's Not!** Why are there such temperature differences at different latitudes? The answer has to do with solar energy. Solar energy heats the Earth. Latitude determines the amount of solar energy a particular area receives. You can see how this works in **Figure 3**. Notice that the sun's rays hit the area around the equator directly, at nearly a  $90^\circ$  angle. At this angle, a small area of the Earth's surface receives more direct solar energy, resulting in high temperatures. Near the poles, however, the sun's rays strike the surface at a lesser angle than at the equator. This lesser angle spreads the same amount of solar energy over a larger area, resulting in lower temperatures.



**Figure 3** The sun's rays strike the Earth's surface at different angles because the surface is curved.



## BRAIN FOOD

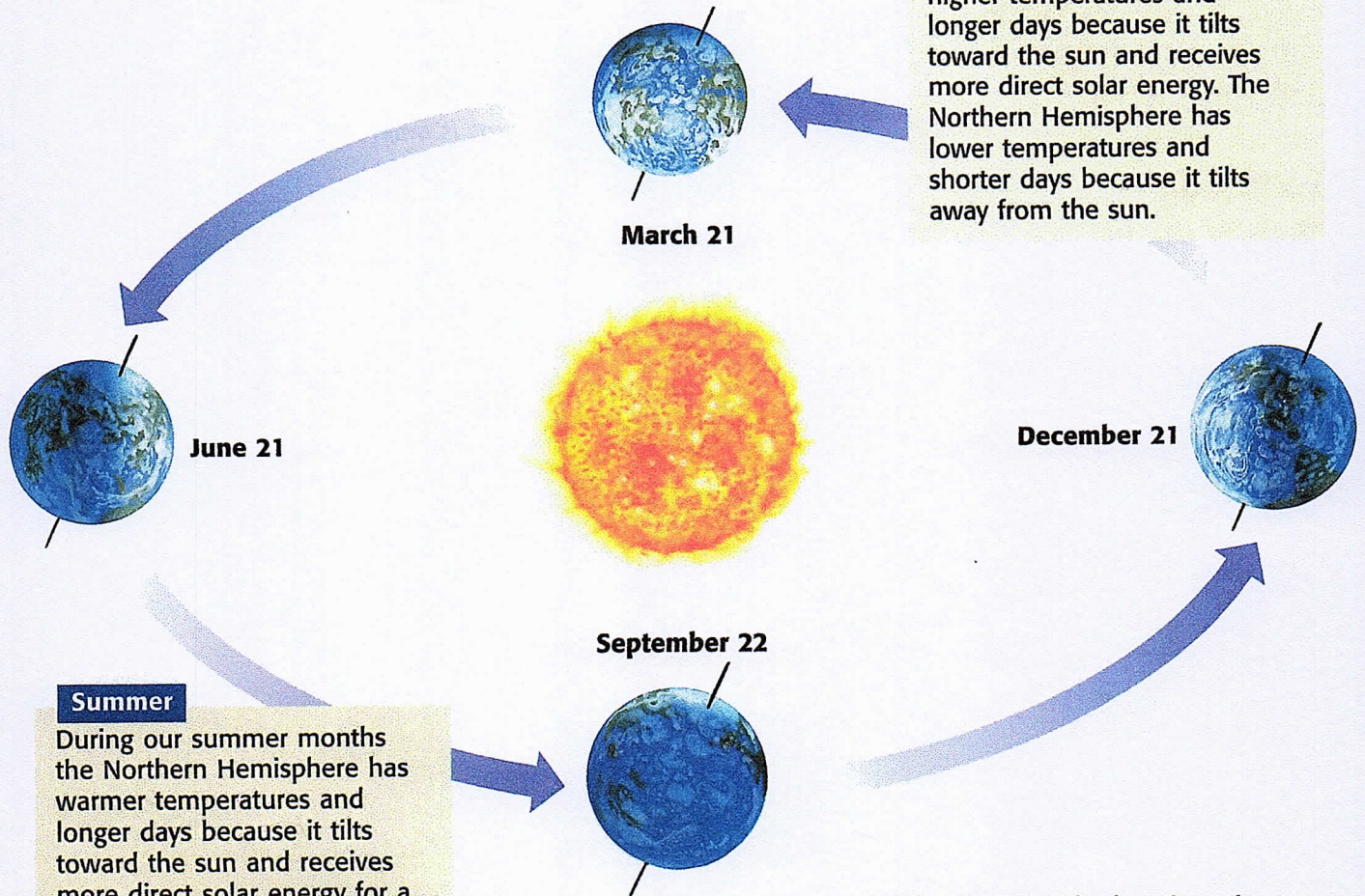


The polar regions receive almost 24 hours of daylight each day in the summer and almost 24 hours of darkness each day in the winter.

**Seasons and Latitude** In most places in the United States, the year consists of four seasons. Winter is probably cooler than summer where you live. But there are places in the world that do not have such seasonal changes. For example, areas near the equator have approximately the same temperatures and same amount of daylight year-round. **Figure 4** shows how latitude determines the seasons.

### Winter

During our winter months the Southern Hemisphere has higher temperatures and longer days because it tilts toward the sun and receives more direct solar energy. The Northern Hemisphere has lower temperatures and shorter days because it tilts away from the sun.



### Summer

During our summer months the Northern Hemisphere has warmer temperatures and longer days because it tilts toward the sun and receives more direct solar energy for a longer amount of time. However, the Southern Hemisphere has colder temperatures and shorter days because it is tilted away from the sun.

**Figure 4** The Earth is tilted on its axis at a  $23.5^\circ$  angle. This tilt affects how much solar energy an area receives as the Earth moves around the sun.



### Self-Check

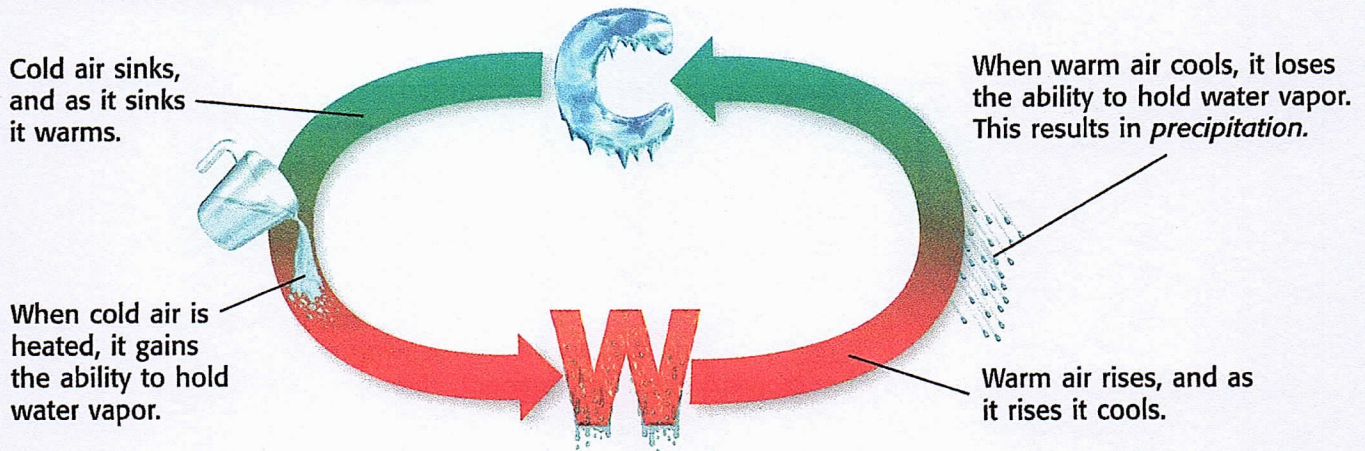
During what months does Australia have summer?  
(See page 136 to check your answer.)



## Prevailing Winds

**Prevailing winds** are winds that blow mainly from one direction. These winds influence an area's moisture and temperature. Before you learn how the prevailing winds affect climate, take a look at **Figure 5** to learn about some of the basic properties of air.

**Figure 5** Because warm air is less dense, it tends to rise. Cooler, denser air tends to sink.



Prevailing winds affect the amount of precipitation that a region receives. If the prevailing winds form from warm air, they will carry moisture. If the prevailing winds form from cold air, they will probably be dry.

The amount of moisture in prevailing winds is also affected by whether the winds blow across land or across a large body of water. Winds that travel across large bodies of water absorb moisture. Winds that travel across land tend to be dry. Even if a region borders the ocean, the area might be dry if the prevailing winds blow across the land, as shown in **Figure 6**.



**Figure 6** The Sahara Desert, in northern Africa, is extremely dry because of the dry prevailing winds that blow across the continent.

## Quick Lab

### A Cool Breeze

1. Hold a **thermometer** next to the top edge of a **cup of water** containing **two ice cubes**. Read the temperature next to the cup.
2. Have your lab partner fan the surface of the cup with a **paper fan**. Read the temperature again. Has the temperature changed? Why? Record your answer in your ScienceLog.

**TRY at HOME**



## Activity

Using a physical map, locate the mountain ranges in the United States. Does climate vary from one side of a mountain range to the other? If so, what does this tell you about the climatic conditions on either side of the mountain? From what direction are the prevailing winds blowing?

TRY at HOME

## Geography

Mountains can influence an area's climate by affecting both temperature and precipitation. For example, Kilimanjaro, the tallest mountain in Africa, has snow-covered peaks year-round, even though it is only about 3° (320 km) south of the equator. Temperatures on Kilimanjaro and in other mountainous areas are affected by elevation. **Elevation** is the height of surface landforms above sea level. As the elevation increases, the atmosphere becomes less dense. When the atmosphere is less dense, its ability to absorb and hold thermal energy is reduced and temperatures are therefore lower.

Mountains also affect the climate of nearby areas by influencing the distribution of precipitation. **Figure 7** shows how the climates on two sides of a mountain can be very different.

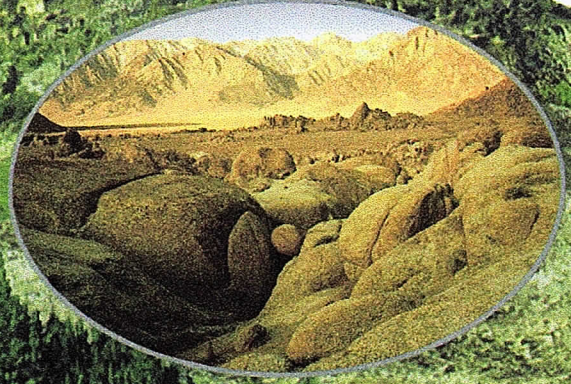
**Figure 7** Mountains block the prevailing winds from blowing across a continent, changing the amount of moisture the wind carries.

### 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 due to the wind losing its moisture.

### The Dry Side

After dry air crosses the mountain, the air begins to sink, warming and absorbing moisture as it sinks. The dry conditions created by the sinking, warm air usually produce a desert. This side of the mountain is in a *rain shadow*.

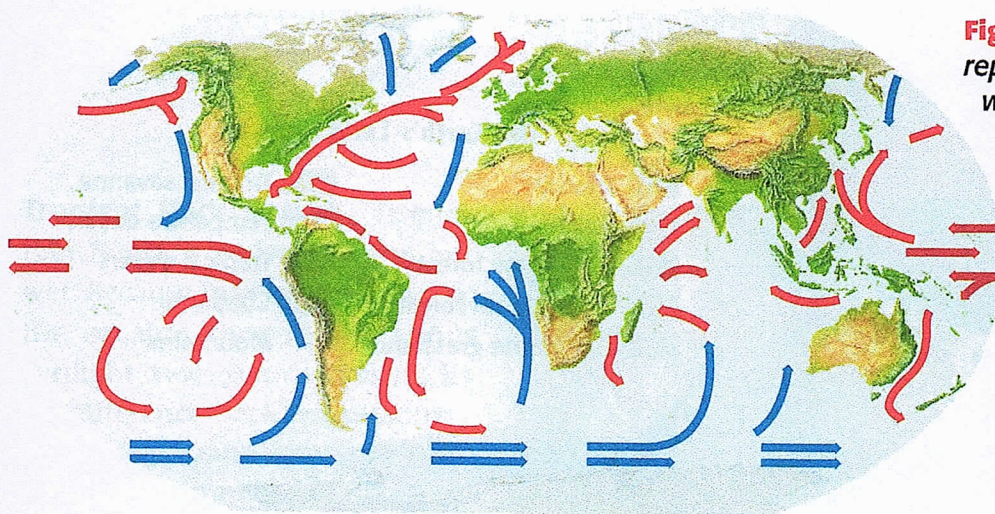




## Ocean Currents

Because of water's ability to absorb and release thermal energy, the circulation of ocean surface currents has an enormous effect on an area's climate. **Surface currents**, which can be either warm or cold, are streamlike movements of water that occur at or near the surface of the ocean. **Figure 8** shows the pattern of the major warm and cold ocean surface currents.

**Current Events** 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 temperatures, while cool currents cool the surrounding air and cause cooler temperatures. For example, the Gulf Stream current carries warm water northward off the east coast of North America past Iceland, an island country located just below the Arctic Circle. The warm water from the Gulf Stream heats the surrounding air, creating warmer temperatures in southern Iceland. Iceland experiences milder temperatures than Greenland, its neighboring island, where the climate is not influenced by the Gulf Stream.



**Figure 8** The red arrows represent the movement of warm surface currents. The blue arrows represent the movement of cold surface currents.

### SECTION REVIEW

1. What is the difference between weather and climate?
2. How do mountains affect climate?
3. Describe how air temperature is affected by ocean surface currents.
4. **Analyzing Relationships** How would seasons be different if the Earth did not tilt on its axis?

## Science CONNECTION

What is El Niño? Can it affect our health? Turn to page 94 to find out.

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