

# WHAT FACTORS AFFECT CLIMATE?

**Climate factors** are the conditions that affect the climate characteristics of a particular location. There are six major natural climate factors: air masses and winds, latitude, ocean currents, elevation, relief, and bodies of water. Some are global factors that affect all parts of Earth. Some are local factors that influence only small parts of Earth.

**climate factor** a natural condition or situation that affects the climate characteristics of a place

## GLOBAL CLIMATE FACTOR: WINDS AND AIR MASSES

Winds and air masses help move energy around the planet.

### WINDS

The zone near the equator is hot. Here, as the air warms and rises, cooler air moves in beneath it. Movements of air along Earth's surface are called winds.

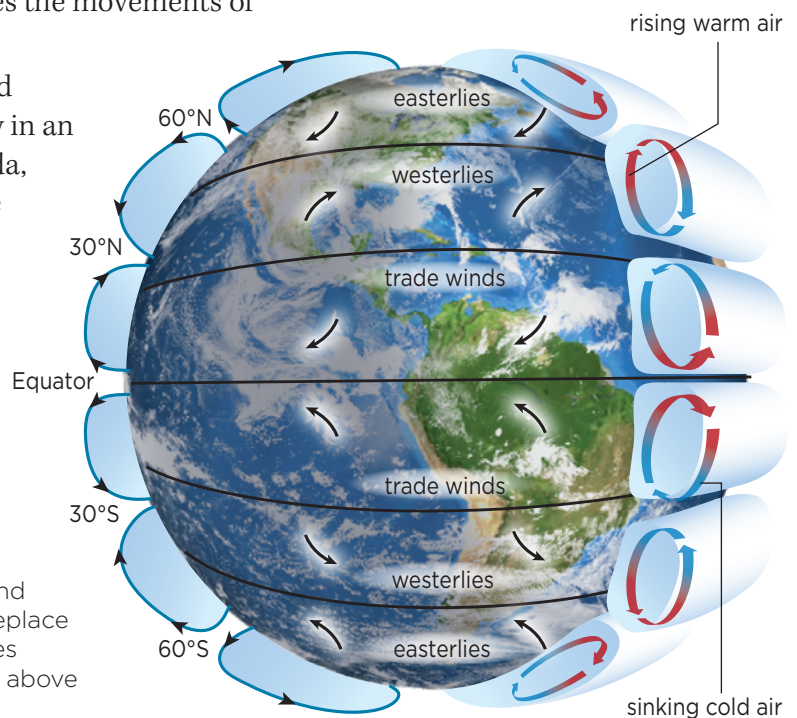
The world's wind systems are complex because of two conditions:

- Earth spins on its axis from west to east. This causes the winds to veer sideways. In the northern hemisphere the winds appear to move to the right. In the southern hemisphere they appear to move to the left.
- Land and water are not evenly distributed over Earth's surface. There is more land in the northern hemisphere than in the southern hemisphere. Since land heats up more quickly than water, there is more warm, rising air in the northern hemisphere. This changes the movements of the winds around the world.

**prevailing wind** the usual or common winds for a particular place

**trade winds** winds that blow steadily toward the equator from the northeast in the northern hemisphere or the southeast in the southern hemisphere

**Figure 2.14** shows the pattern of global wind systems. The wind that blows most commonly in an area is the **prevailing wind**. For most of Canada, the prevailing winds are from the west and are called the prevailing westerlies. **Trade winds** are winds that blow steadily toward the equator from the northeast in the northern hemisphere or the southeast in the southern hemisphere, especially at sea.



**FIGURE 2.14** As warm air rises, cooler air slides in underneath, and the warmer air moves along to replace the cooler air. This creates a series of cycles of rising and sinking air above Earth's surface.

## AIR MASSES

An **air mass** is a large body of air that has similar temperature and moisture conditions throughout.

Air masses that form over warm bodies of water pick up moisture and heat from the water (Figure 2.15). As the global winds carry the air masses along, they bring warm, wet weather, which affects the land areas under them. Air masses that begin over land tend to be dry.

**air mass** a large volume of air with similar conditions of temperature and moisture throughout

North American Air Mass Systems

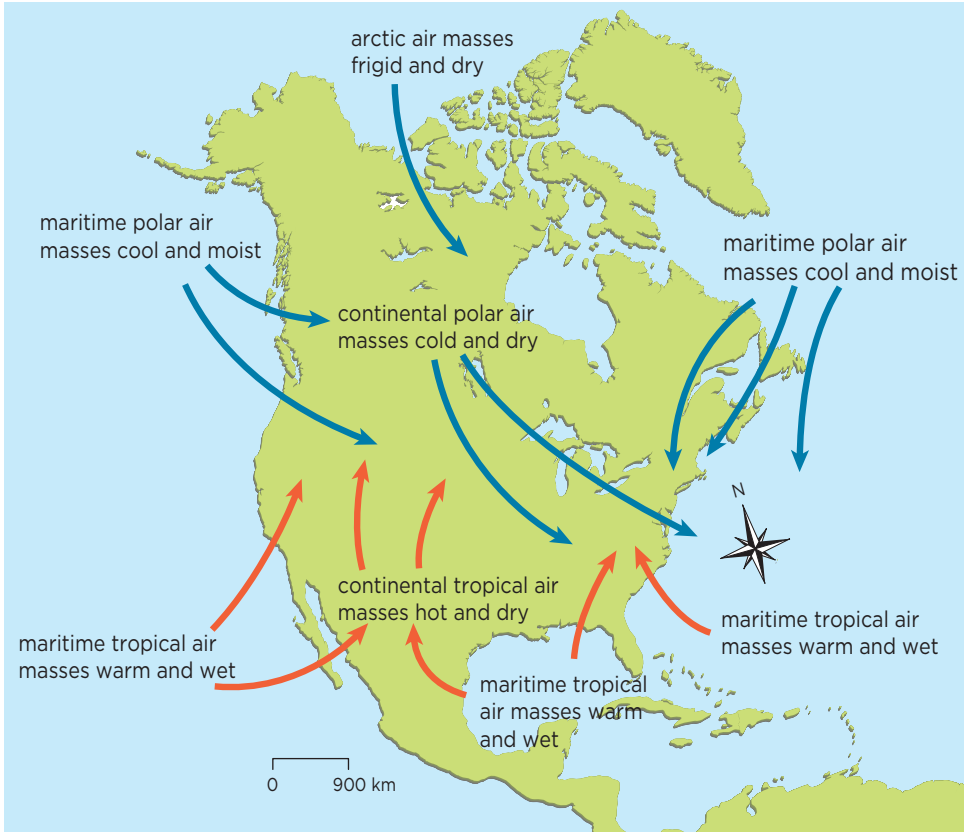
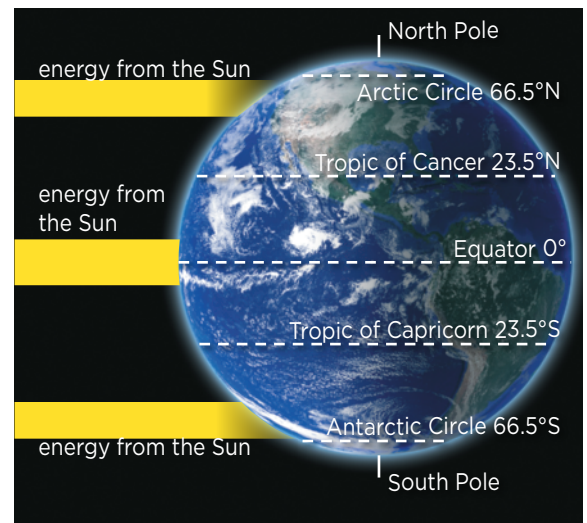


FIGURE 2.15 This diagram shows air mass systems in North America.

## GLOBAL CLIMATE FACTOR: LATITUDE

Latitude describes how far north or south a place is from the equator. It is measured in degrees. The places closest to the equator ( $0^\circ$  latitude) receive more concentrated, direct energy from the Sun than those farther from the equator (Figure 2.16). In areas of higher latitudes (farther from the equator), energy from the Sun is spread over a larger area and is less concentrated. Places with lower latitudes tend to have warmer climates than those at higher latitudes.

FIGURE 2.16 When sunlight strikes a sloped surface, its energy is spread out over a larger area. Sunlight shines more directly on the equator, so its energy is more concentrated there.



## GLOBAL CLIMATE FACTOR: OCEAN CURRENTS

Oceans make up about 70 percent of Earth's surface. Within the oceans are massive flows of water called **ocean currents**. Ninety percent of ocean currents are cold deep-water currents. Cold currents begin in the polar regions and bring cool water toward the equator. The remaining 10 percent of ocean currents are warm surface currents. Warm currents start in the tropics and bring warm water into cooler regions. These currents either warm or cool the climates of land areas nearby.

The movement of cold and warm currents creates a global ocean circulation system. This system has been called a conveyor belt because the ocean waters travel around the world in a long, slow loop. It would take about a thousand years for a single particle of water to make one complete circuit of the global ocean circulation system.

**ocean current** a flow of water within an ocean influenced by winds, gravity, and the spinning of Earth on its axis

### GEOGRAPHY AT WORK

## CLIMATOLOGIST

Climatologists study climate. They study weather patterns and the factors that affect them (**Figure 2.17**). Climatologists use long-term weather data to identify trends and understand their causes. They make predictions about how the climate will change.

Dr. Chris Funk (**Figure 2.18**) is a geographer with the United States Geological Survey. He specializes in climatology and is studying climate change in Africa and Central America. He examines data from satellite images and monitoring stations in those regions in order to better understand rainfall patterns. This will



**FIGURE 2.17** Climatologists use devices such as these to gather weather data. These climatologists are on Ellesmere Island, Canada.

help governments and other organizations predict droughts and food shortages so they can deliver food aid to the affected regions quickly.

Dr. Funk is developing computer models of climate change. His models require a large amount of climate data. This includes data on rainfall patterns in East Africa and water temperatures in the Pacific and Indian oceans. Geographers and climatologists in Africa and Central America share their data, which helps improve everyone's ability to make better predictions.

One of the most satisfying parts of Dr. Funk's job is helping vulnerable people. As he says, "We help identify people in harm's way."

This will in turn help people to respond promptly to the challenges of climate change.



**FIGURE 2.18** Dr. Chris Funk, geographer and climatologist

### MAKING CONNECTIONS

1. What skills do climatologists need to have?
2. Name three things that interest you about climatology. What else would you like to learn about this career?

# GATHER AND ORGANIZE

To investigate a research question, you must first begin by gathering information. As you gather your information, ask yourself these questions:

- Where can I find the data I need? What primary and secondary sources can I use? What studies apply to my research question?
- Is the data relevant to my inquiry question or topic?
- Where does the data come from? To what degree should I trust this source?
- What is the purpose or intent of each source?
- What other sources can I look at to understand other perspectives on my topic?
- What is the point of view in each source?
- What other inquiry questions or topics could the information be used to support?
- How will I record where I found the information?

## ORGANIZING GEOGRAPHIC INFORMATION

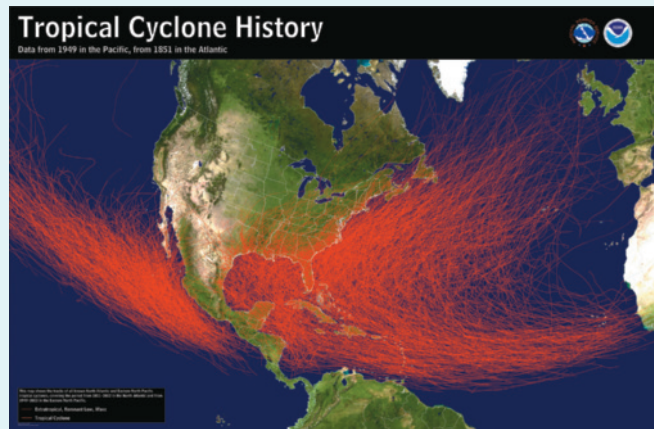
Graphic organizers can help you record and make sense of the evidence you collect. A t-chart can be used to connect two sets of ideas, such as similarities and differences, or facts and opinions. A Venn diagram can be useful for comparing characteristics, especially where there is some overlap. A wheel-and-spoke diagram can show how a number of ideas or facts are connected to one main idea. What other graphic organizers are you familiar with?

## UNDERSTANDING HURRICANES

Consider this research question: Why do hurricanes, such as Hurricane Sandy, mainly affect only the southeastern part of North America?

To answer this question, you need to think about the climate factors that influence the formation of hurricanes. As you read the information below, think about how you would organize it to help you understand the research question.

Hot tropical air is critical to hurricane development. As hot air rises quickly, colder air rushes in to the lower-pressure area. Clouds build rapidly, and the moving air swirls to create a low-pressure cyclone.



**FIGURE 2.19** The track of known North Atlantic (1851–2012) and eastern North Pacific (1949–2012) tropical cyclones

Most hurricanes that begin near Africa are brought westward across the Atlantic Ocean by trade winds. These storms veer to the right (northward) in the northern hemisphere (**Figure 2.19**). They meet the dominant westerlies, which push them eastward and northward.

As hurricanes pass over the warm Gulf Stream, the surface air is heated, adding moisture. This warm air rises, lowering air pressure in the eye of the hurricane and adding wind speed.

When Atlantic hurricanes move over land they meet the Appalachian Mountains and are forced upward, cooling the air. The high relief and orientation (southwest—northeast) block the hurricanes from the interior and force them eastward and northward.

## TRY IT

1. Select an appropriate graphic organizer and record the facts above to help you better understand the research question. Use the climate factors discussed in this section as a guide. A sketch map may also be helpful.
2. Do you need to gather other information to help answer the question? If so, where can you find it?

## LOCAL CLIMATE FACTOR: ELEVATION

Elevation affects local climate. As elevation increases, temperatures become cooler. This has to do with air density, or how close or far apart air molecules are from each other. Air molecules are held together by gravity. The higher up they are, the harder it is for gravity to hold them together. At higher elevations, air molecules are spaced farther apart, meaning the air is less dense. The air is less able to trap heat from the Sun, so temperatures are cooler. At lower elevations, air molecules are closer together, meaning the air is more dense. The air is better able to trap heat, so temperatures are warmer.

## LOCAL CLIMATE FACTOR: RELIEF

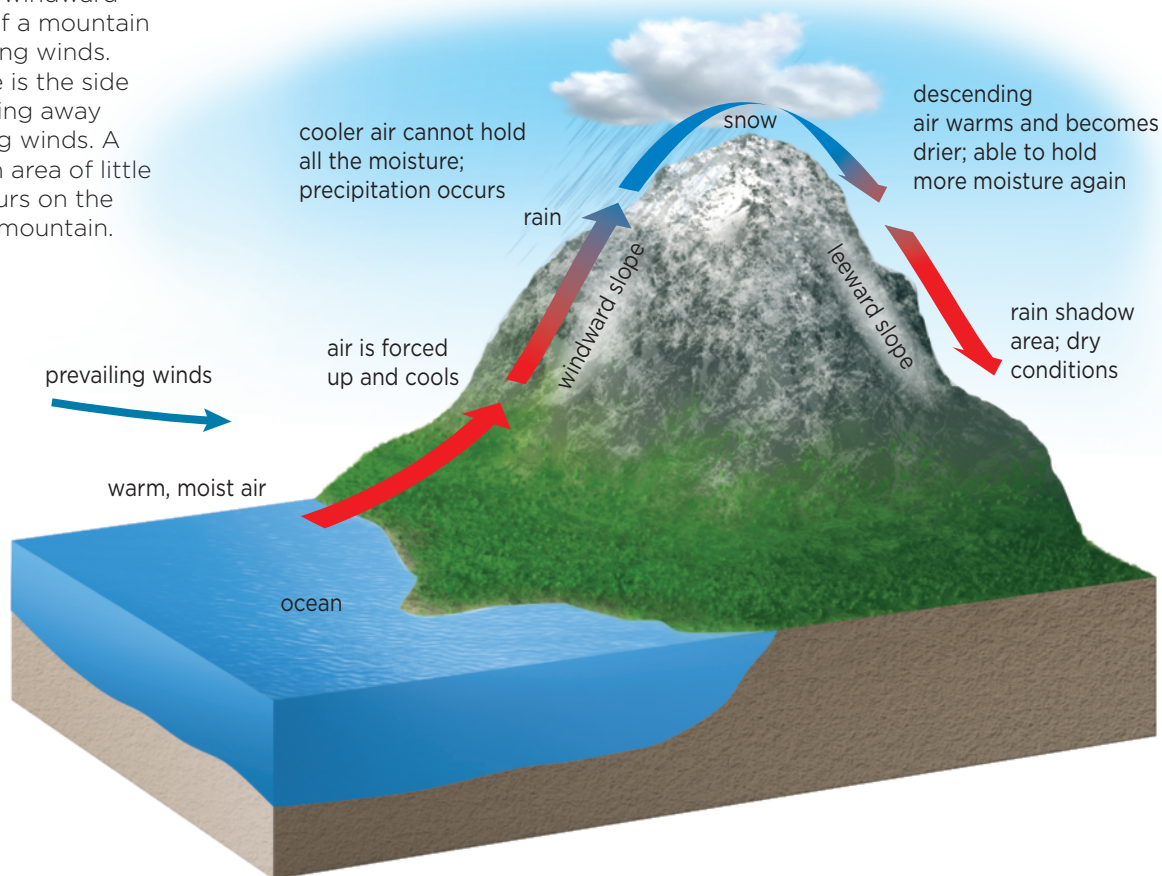
Geographers use the term **relief** to describe the difference in height between the highest point and the lowest point in an area. Mountainous areas have high relief (large differences between highest and lowest points), and plains have low relief (small differences). Places of high relief can have a big impact on precipitation.

As you can see in **Figure 2.20**, relief causes one side of a mountain to have much higher precipitation rates than the other. The windward side of the mountain receives more rain than the drier leeward side. The mountain causes the moist air to rise. As the air rises, it cools. Moisture in the air condenses and falls to Earth. This type of precipitation is called **relief precipitation**.

**relief** differences in elevation between the highest places and the lowest places in an area

**relief precipitation** rain or snow that occurs as a result of air rising over mountains

**FIGURE 2.20** The windward slope is the side of a mountain facing the prevailing winds. The leeward slope is the side of a mountain facing away from the prevailing winds. A rain shadow, or an area of little precipitation, occurs on the leeward side of a mountain.

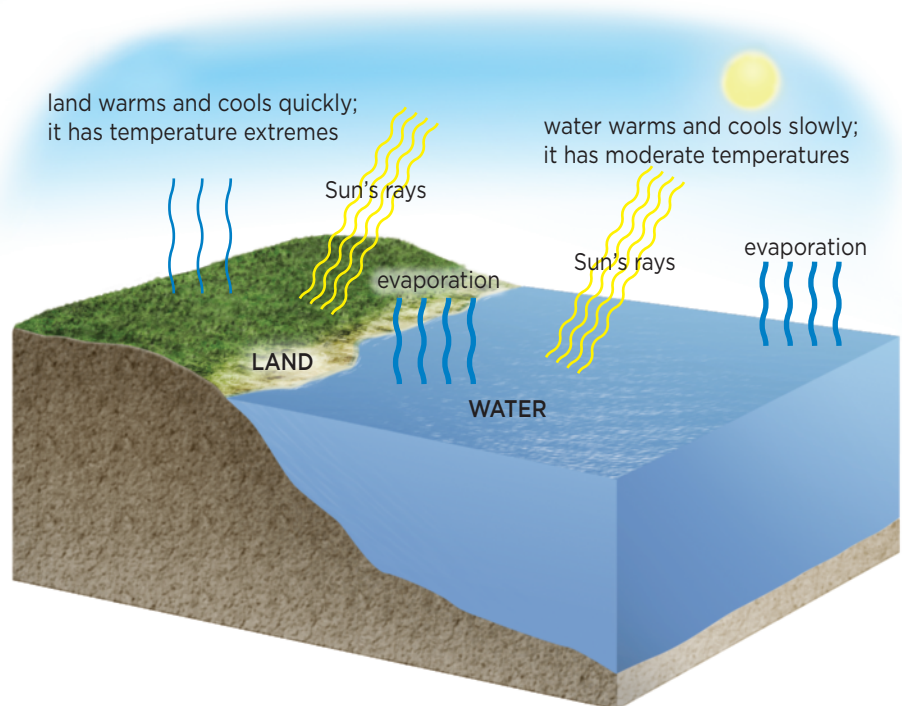


## LOCAL CLIMATE FACTOR: BODIES OF WATER

Figure 2.21 shows that bodies of water such as lakes and oceans affect the temperatures and the levels of precipitation on nearby land.

- Bodies of water take a long time to heat up or cool down compared to the land around them. This helps keep the temperatures of the land nearby from becoming too extreme. In winter, the heat from the bodies of water warms the air above it. The air then blows over the land and warms it. In summer, bodies of water cool the air above them, which blows over the land nearby and cools it.
- Bodies of water provide moisture to nearby land. Water evaporates from the surface of water bodies into the air above it. Winds pick up the moisture and carry it over the land, where it then falls as rain or snow. This is one reason that places near large bodies of water usually have higher rates of precipitation than those farther away.

Why do many people want to vacation near a lake or ocean when the weather is warm?



**FIGURE 2.21** Land heats up and cools down more quickly than bodies of water. You can see this in early winter when the land is covered with snow and water bodies are not yet frozen.

### CHECK-IN

- EVALUATE AND DRAW CONCLUSIONS** What factors shape the climate where you live? Identify three of the most important ones. Give a reason why you think each one is important.
- PATTERNS AND TRENDS** Use the six climate factors described in this section to explain the following climate conditions:
  - Cities in the middle of continents are more likely to experience drought than cities along a coast.
  - London, United Kingdom, is located farther north than Ottawa, Canada, yet it has a warmer climate than Ottawa.
  - Mount Kilimanjaro in Tanzania often has snow on its top even though it is located close to the equator.
  - The driest place on Earth is the Atacama Desert, high in the Andes Mountains of South America.
  - The Grand Banks off the coast of Newfoundland is considered the foggiest place on Earth.Share your answers with a partner, making sure that you name the climate factors that are important in each situation.
- INTERPRET AND ANALYZE** Reread the description of Hurricane Sandy on page 44. Which climate factors were most important in creating this devastating weather event? Give reasons for your choices.