

# HOW IS THIS CLIMATE DIFFERENT FROM YOURS?



## What factors affect Earth's climate?

On this icy, frozen island in Svalbard, Norway, the sun shines all day and night from mid-April to mid-August. Winter is long and cold, with three months of complete darkness. The average winter temperature is  $-12^{\circ}\text{C}$ . But the average annual precipitation, mainly snow, is only about 20 centimeters. The island is located above the Arctic Circle, and scientists study glaciers, the environment, and meteorology there to detect climate changes.

**Develop Hypotheses** How might this island climate in Norway be different from your climate?

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Watch the **Untamed Science** video to learn more about Earth's climate.





# Climate

## Tennessee Academic Standards for Science

**6.LS2.4** Using evidence from climate data, draw conclusions about the patterns of abiotic and biotic factors in different biomes, specifically the tundra, taiga, deciduous forest, desert, grasslands, rainforest, marine, and freshwater ecosystems.

**6.ESS2.3** Construct an explanation for how atmospheric flow, geographic features, and ocean currents affect the climate of a region through heat transfer.

**6.ESS2.4** Apply scientific principles to design a method to analyze and interpret the impact of humans and other organisms on the hydrologic cycle.

**6.ESS2.5** Analyze and interpret data from weather conditions, weather maps, satellites, and radar to predict probable local weather patterns and conditions.

# Getting Started

## Check Your Understanding

1. **Background** Read the paragraph below and then answer the question.

Derek walks steadily up the path. As he climbs to a higher **altitude**, the air changes. He can feel the **temperature** get cooler. Soon, he puts up his hood to stay dry. At first the **precipitation** is rain, but as Derek gets higher up the mountain, it changes to snow.

- Why does the precipitation change to snow as Derek gets higher up the mountain?

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**Altitude** is the height of a place above sea level.

**Temperature** is a measure of how hot or cold an object is compared to a reference point.

**Precipitation** is any form of water that falls from clouds and reaches Earth's surface.

## Vocabulary Skill

**High-Use Academic Words** Learning high-use words will help you understand, discuss, and write about the science content in this chapter. These words differ from key terms because they appear in many other subject areas.

Word	Definition	Example
<b>affect</b>	v. to produce a change in or have an effect on	The actions of humans <i>affect</i> the environment.
<b>distinct</b>	adj. different; not the same	Each type of cloud is <i>distinct</i> .

2. **Quick Check** Choose the best word from the table to complete each sentence.

- Trees in the rain forest form several \_\_\_\_\_ layers.
- If you are high up on a mountain, the altitude can \_\_\_\_\_ how you breathe.

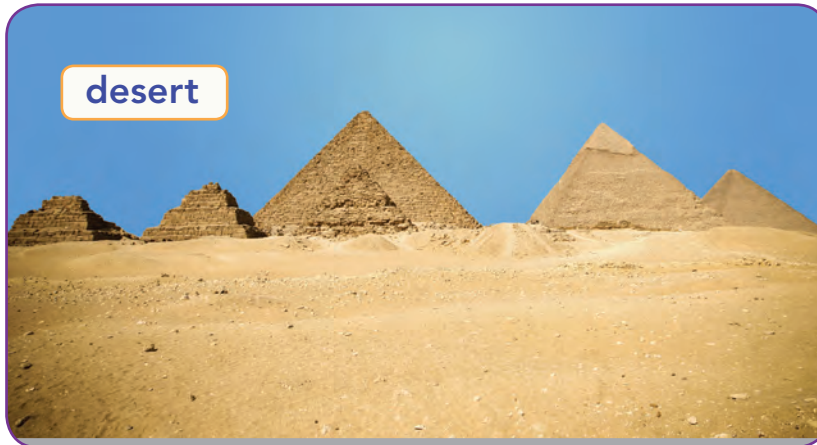




climate



savanna



desert



tundra

## Chapter Preview

### LESSON 1

- climate
- tropical zone
- polar zone
- temperate zone
- marine climate
- continental climate
- windward
- leeward
- monsoon

🎯 Summarize

📌 Infer

### LESSON 2

- rain forest
- savanna
- steppe
- desert
- humid subtropical
- subarctic
- tundra
- permafrost

🎯 Identify the Main Idea

📌 Communicate

🚩 **CCC: Cause and Effect**



# Scenario Investigation

## What Causes Our Climate?

 **SEP: Obtaining, Evaluating, and Communicating Information**

**Purpose** To investigate factors affecting your local climate

**Materials**

- map of the United States
- colored pencils
- pen or pencil

### Scenario

As a climatologist, a person who studies climate, you often receive calls from newspaper reporters asking for your thoughts on each new claim about global climate change.

Today's phone call was different. The reporter who called is writing an article about the climate in your town. The reporter is interested in the roles that six different factors (latitude, prevailing wind direction, nearby bodies of water, mountain ranges, ocean currents, and altitude) play in determining the climate.

By tomorrow, you have promised to send the reporter a map with all the factors marked on it and one paragraph for each factor explaining how that factor contributes to your local climate. Your teacher will provide you with latitude and altitude information, and it's up to you to find out about the prevailing wind direction, important bodies of water, and mountains.

### Procedure

- 1. Put Your Town on the Map** Your teacher will provide you with a map of the United States. Neatly mark your town and write the name of your town on the map.
- 2. Latitude Attitude** Draw a horizontal line through your town and write the latitude on the line.
- 3. Which Way Is the Wind Blowing** Draw a red arrow to indicate the prevailing wind direction. Make the arrow long enough so that it passes over water and/or mountains that influence your climate.
- 4. Water and Currents** Before the wind reaches your town, does it blow across a large body of water? If so, draw and write the name of the body of water on your map. Is there an ocean current that warms or cools the air? If so, draw a blue arrow to show the direction of the current.
- 5. Mountains in the Way?** If the prevailing winds flow over mountains, that will affect the moisture content of the air. On your map, draw and write the names of any mountains that influence your town's climate.
- 6. How High Are We?** Finally, the reporter wants the town's altitude. Once your teacher tells you the town's altitude, write it on your map near the name of your town.

## Conclusion

Let's see what you learned about the factors that contribute to your town's climate.

- 1.** Which factor(s) is most responsible for your average temperature? Explain.



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- 2.** Which factor(s) is most responsible for the amount of precipitation your town gets? Explain.

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- 3.** In what climate region is your town located? How do you know?

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On a piece of paper, write what you will say in your e-mail to the reporter. Include an introduction that summarizes what your map shows, and two or three sentences for each factor (latitude, prevailing wind direction, water, mountains, ocean currents, and altitude) describing how it affects your town's climate. Be sure to explain how each factor affects the temperature and/or precipitation for your town. Refer to information on the map in your descriptions. Use your textbook to check your facts.





6.LS2.4, 6.ESS2.3

# What Causes Climate?



What Factors Affect Temperature?

What Factors Affect Precipitation?

## my planet DiARY

### Changes in Climate

**Misconception:** Only changes in the atmosphere can affect climate.

**Fact:** As air moves, it's affected by sunlight, cloud cover, oceans, and even landforms such as mountains.

**Evidence:** The ocean plays a big role in shaping climate. For example, rain that falls in the mountains eventually runs into rivers and oceans. Then water evaporates from the oceans and forms clouds. Water in the oceans also absorbs heat. Ocean currents transfer thermal energy from the equator to cooler areas in the Northern and Southern hemispheres.

## MISCONCEPTION

Think about your own observations of Earth's climate. Then answer these questions with a partner.

1. How does the ocean affect Earth's climate?

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2. How do you think the climate in coastal areas differs from the climate farther inland?

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Do the Inquiry Warm-Up  
*How Does Latitude Affect Climate?*



## Vocabulary

- climate
- tropical zone
- polar zone
- temperate zone
- marine climate
- continental climate
- windward
- leeward
- monsoon

## Skills

-  Reading: Summarize
-  Inquiry: Infer

# What Factors Affect Temperature?

No matter where you live, the weather changes every day. In some areas, the change might be as small as a 1-degree drop in temperature from one day to the next. In other areas, it can mean a cold, rainy day followed by a warm, sunny one. Climate, on the other hand, is the long-term weather pattern in an area. Specifically, **climate** refers to the average, year-after-year conditions of temperature, precipitation, wind, and clouds in an area. Both weather and climate depend on the transfer of thermal energy and water into and out of the atmosphere.



Temperature changes cause evaporation and precipitation. The water cycle determines climate patterns. For example, in California's Mojave Desert, shown in **Figure 1**, there is more evaporation than precipitation. The climate there is hot and dry. If you moved west from the Mojave desert toward California's coast, you'd notice a different climate. It would be cooler and more humid. How is this possible?  **Temperature is affected by latitude, altitude, distance from large bodies of water, and ocean currents.**

FIGURE 1 .....

### Climate

 **List** Make a short list of words comparing the climate of the Mojave with the climate of the area in which you live.

Mojave's Climate:	Your Climate:





 **Summarize** Read about latitude. Then summarize in your own words how latitude affects temperature.

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**Latitude** In general, areas near the equator have warmer climates than areas far from the equator. The reason is that the sun's rays hit Earth's surface more directly at the equator than at the poles. At the poles, the same amount of solar radiation is spread over a larger area, which brings less warmth.

Recall that latitude is the distance from the equator, measured in degrees, as shown in **Figure 2**. Based on latitude, Earth's surface can be divided into three types of temperature zones.

The **tropical zone** is the area near the equator, between about 23.5° north latitude and 23.5° south latitude. It receives direct or nearly direct sunlight all year, making climates there warm.

In contrast, the sun's rays always strike at a lower angle near the North and South poles, making climates there cold. These **polar zones** extend from about 66.5° to 90° north and 66.5° to 90° south latitudes.

Between the tropical zones and the polar zones are the **temperate zones**. In summer, the sun's rays strike the temperate zones more directly. In winter, the sun's rays strike at a lower angle. As a result, the weather in the temperate zones ranges from warm or hot in summer to cool or cold in winter.

**Key**

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

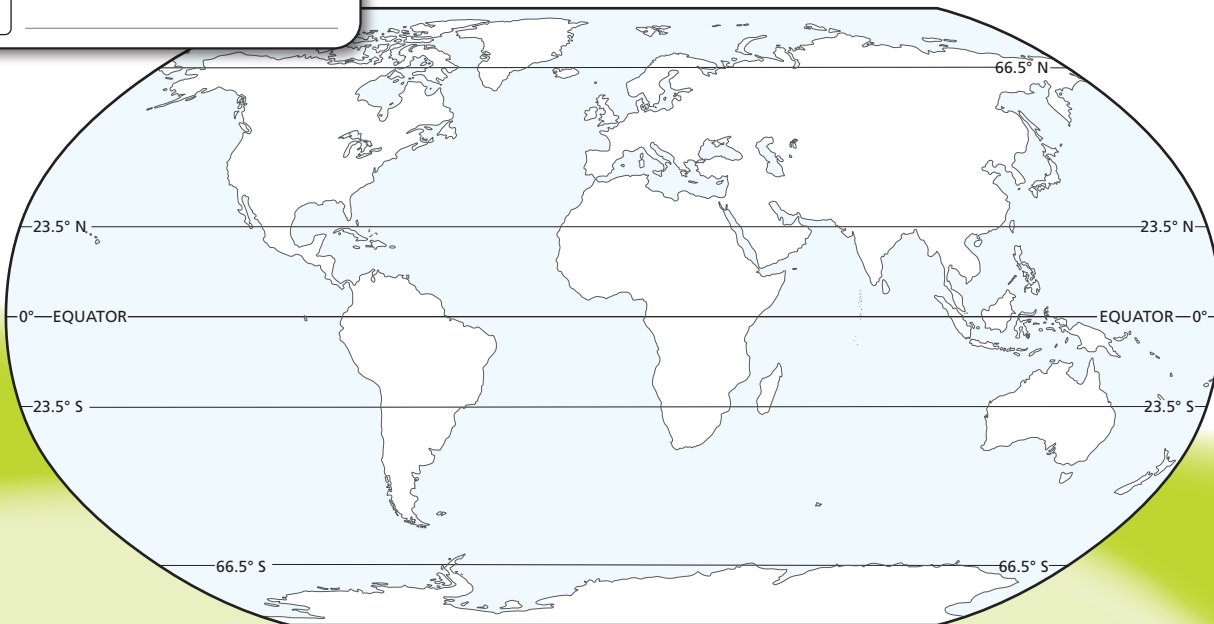



FIGURE 2 .....

**Latitude and Temperature**

 Use the map above to complete the activity.

- 1. Relate Text and Visuals** Shade in the three temperature zones differently on the map and complete the key.
- 2. Observe** In which temperature zone is most of the United States located?

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**Altitude** Standing at 6,309 meters high, Mount Chimborazo is Ecuador’s tallest mountain. Its peak is covered in glaciers year-round, as shown in **Figure 3**. But at 1° south latitude, Chimborazo is located very close to the equator. How does the top of this mountain stay so cold?

In the case of high mountains, altitude is a more important climate factor than latitude. In the troposphere, temperature decreases about 6.5°C for every 1-kilometer increase in altitude. As a result, many mountainous areas have cooler climates than the lower areas around them. Chimborazo is just over 6 kilometers high. The air at the top of this mountain is about 39°C colder than the air at sea level at the same latitude.



**did you know?** .....

A species of *Polylepsis* tree in Bolivia grows at the highest altitude of any tree in the world—up to 5,200 m.

FIGURE 3 .....

**Altitude and Temperature**

 Read about altitude and answer these questions.

**1. Name** Use **Figure 2** to identify the temperature zone in which Ecuador is located. (*Hint*: Ecuador is in northwestern South America.)

\_\_\_\_\_

**2. Calculate** If it was 30°C at the base of Mount Chimborazo, about how cold would it be at the peak?

\_\_\_\_\_

**3. Interpret Photos** Use the photo below to compare the conditions at the base of Mount Chimborazo with the conditions at the peak.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_







**Vocabulary High-Use Academic Words** Complete the sentence to show you understand the meaning of the word *affect*. The ocean is too far from the middle of North America to \_\_\_\_\_

**Distance From Large Bodies of Water** Oceans or large lakes can also affect temperatures. Oceans greatly moderate, or make less extreme, the temperatures of nearby land. Water heats up about five times more slowly than land. It also cools down more slowly. Therefore, winds off the ocean often prevent extremes of hot and cold in coastal regions. Much of the west coasts of North America, South America, and Europe have **marine climates**. These climates have relatively mild winters and cool summers.

The centers of North America and Asia are too far inland to be warmed or cooled by the ocean. Most of Canada, Russia, and the central United States have **continental climates**. These climates reach more extreme temperatures than marine climates. Winters are cold, while summers are warm or hot.

## apply it!

Alaska is about twice the size of Texas. Factors influencing temperature, such as distance from large bodies of water, affect this big state in different ways.

**1 Observe** Where are Juneau and Fairbanks located in relation to each other?

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**2 Infer** Which climate data do you think describe Juneau, A or B? Which describe Fairbanks, A or B? Why?

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**3 CHALLENGE** Which city on the map do you think represents the set of data for City C? Why?

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	City A	City B	City C
Average Number of Days Below $-17^{\circ}\text{C}$ ( $0^{\circ}\text{F}$ )	113	6	168
Average Number of Days Above $18^{\circ}\text{C}$ ( $65^{\circ}\text{F}$ )	82	40	2

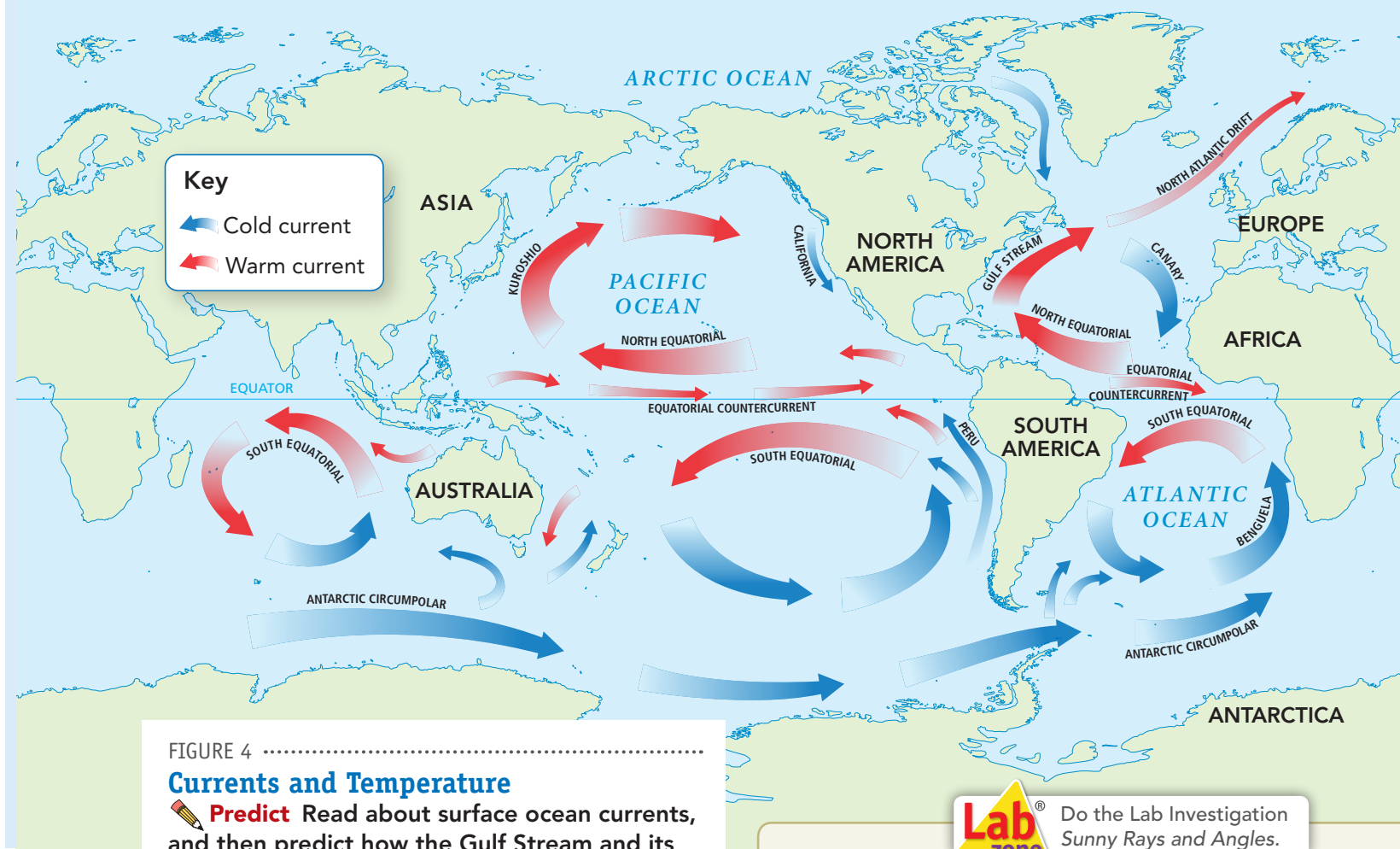


FIGURE 4 .....

### Currents and Temperature

**Predict** Read about surface ocean currents, and then predict how the Gulf Stream and its continuation, the North Atlantic Drift, affect the climate in western Europe.

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**Ocean Currents** Marine climates are influenced by ocean currents—streams of water within the oceans that move in regular patterns. Surface currents are driven mostly by global winds. Deep currents form as cold, salty water becomes more dense, sinks, and flows slowly along the ocean floor.

Some warm ocean currents move from the tropics toward the poles. This warm ocean water warms the air above it. The warmed air then moves over nearby land, affecting climate. The best-known warm-water current is the Gulf Stream. When it crosses the North Atlantic, it becomes the North Atlantic Drift. Cold currents affect climate by bringing cold water from the polar zones toward the equator. A cold current brings cool air. The California Current is a cold current.



Do the Lab Investigation *Sunny Rays and Angles.*

### Assess Your Understanding


- 1a. **Define** How does climate differ from weather?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
- 1b. **Identify** Name the three temperature zones.  
 \_\_\_\_\_  
 \_\_\_\_\_

### got it? .....

- I get it! Now I know that there are several factors that affect temperature: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
- I need extra help with \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# What Factors Affect Precipitation?

The amount of precipitation that falls in an area can vary yearly. But, over time, total precipitation tends toward a yearly average.

 **The main factors that affect precipitation are prevailing winds, presence of mountains, and seasonal winds.**

**Prevailing Winds** Weather patterns depend on the movement of huge air masses. Prevailing winds are the winds that usually blow in one direction in a region. These winds move air masses from place to place. Air masses can be warm or cool, dry or humid. The amount of water vapor in the air mass influences how much rain or snow might fall.


The amount of water vapor in a prevailing wind depends on where the wind blows from. For example, winds that blow inland from oceans or large lakes carry more water vapor than winds that blow from over land.

**Mountain Ranges** A mountain range in the path of prevailing winds can also influence where precipitation falls. When humid winds blow from the ocean toward coastal mountains, they are forced to rise. The rising air cools and its water vapor condenses, forming clouds, as shown in **Figure 5**. Rain or snow falls on the **windward** side of the mountains, the side the wind hits.

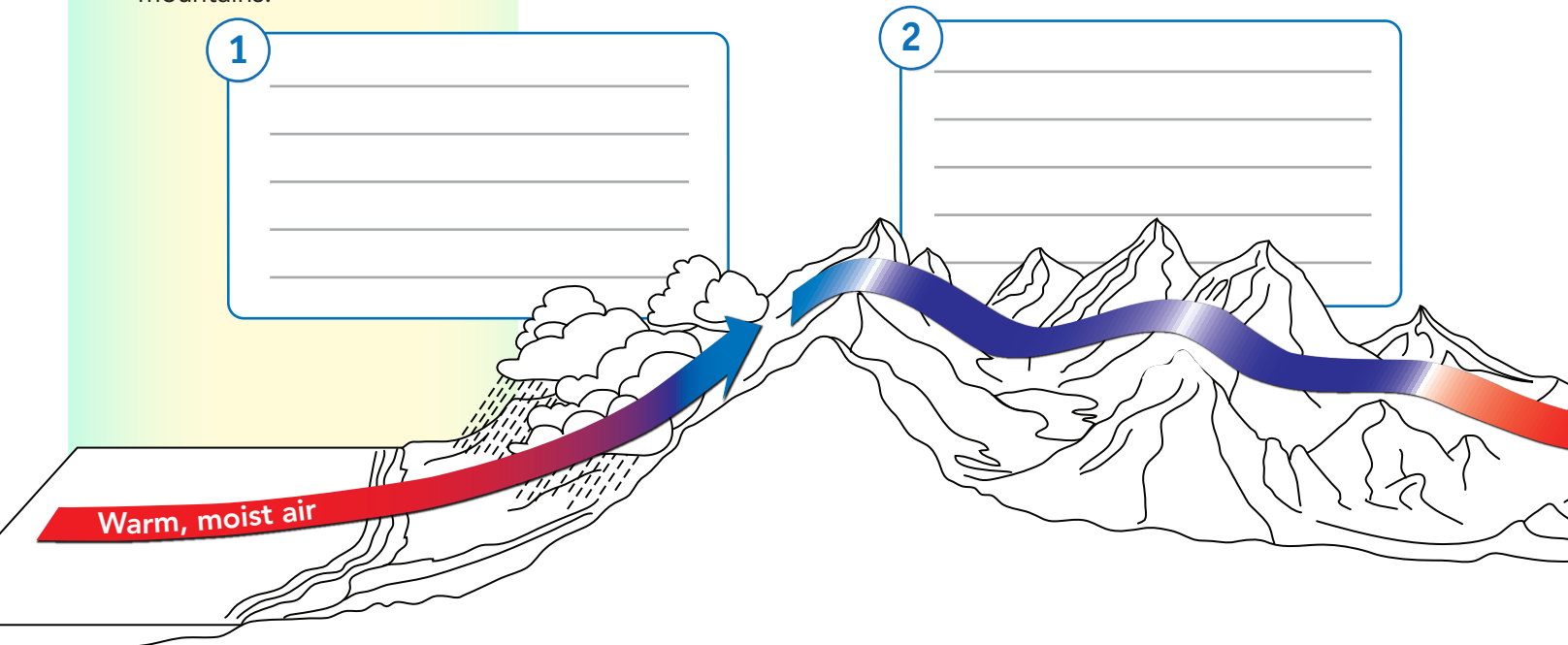
By the time the air has moved over the mountains, it has lost much of its water vapor, so it's cool and dry. The land on the **leeward** side of the mountains—downwind—is in a rain shadow. Little precipitation falls there.

FIGURE 5 .....

## Rain Shadow

 Read about how mountains can form a barrier to humid air. Then complete the activity.

- 1. Sequence** Fill in the boxes to describe what happens as prevailing winds meet mountains.
- 2. Apply Concepts** Shade in the landscape to show what the vegetation might look like on both sides of the mountains.





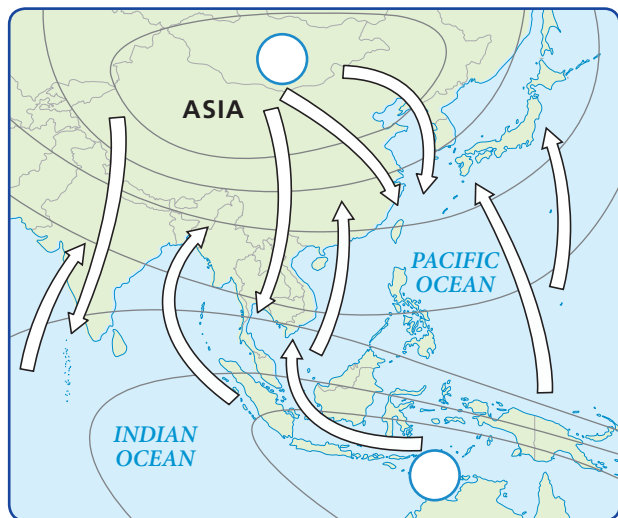



FIGURE 6 .....

### Monsoons

Monsoons are seasonal winds that bring drastic changes in precipitation.

 Read about seasonal winds below, and then complete the activity.

1. **Relate Cause and Effect** Shade in the arrows that indicate a summer monsoon.
2. **Identify** Write an *H* or *L* in the circles on the map to indicate the areas of high pressure and low pressure during the summer monsoon.

**Seasonal Winds** In some parts of the world, a seasonal change in wind patterns can affect precipitation. Sea and land breezes over a large region that change direction with the seasons are called **monsoons**. What produces a monsoon? In the summer in South and Southeast Asia, the land gradually gets warmer than the ocean. A wind blows inland from the ocean all summer, even at night. Winds blow from areas of high pressure to areas of low pressure. The air blowing from the ocean during this season is very warm and humid. As the humid air rises over the land, the air cools. This cooling air causes water vapor to condense into clouds, producing heavy rains. In winter, the land becomes colder than the ocean. A wind blows from the land to the ocean. These winds carry little moisture.

**Lab zone**<sup>®</sup> Do the Quick Lab  
*Inferring United States  
 Precipitation Patterns.*

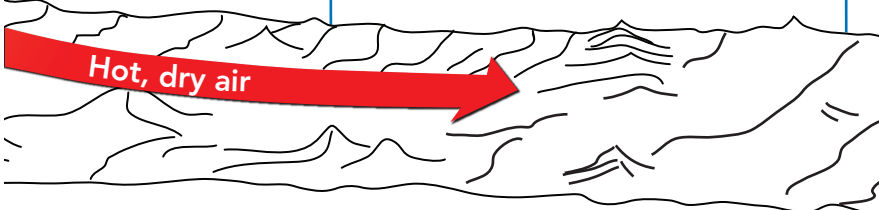
### Assess Your Understanding

- 2a. **Define** What is the leeward side of a mountain?  
 \_\_\_\_\_  
 \_\_\_\_\_
- b. **Summarize** How do prevailing winds affect precipitation?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### got it? .....

- I get it! Now I know three factors affect precipitation: \_\_\_\_\_  
 \_\_\_\_\_
- I need extra help with \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

3 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_





6.LS2.4, 6.ESS2.3

# Climate Regions



🔑 How Do Scientists Classify Climates?

🔑 What Are the Six Main Climate Regions?



## my planet DiARY

## FUN FACT

### Rain, Rain Every Day

When you think of Hawaii, warm, sunny days spent surfing monster waves are probably the first thing that comes to mind. But Hawaii gets its fair share of rain, too. In fact, it's home to one of the wettest places on Earth—Mount Waialeale.

A lush mountain on the island of Kauai, Waialeale gets an average of 1,143 centimeters, or 450 inches, of rain every year. That's more than an inch of rain every day! Yet nearby parts of Kauai get only 10 inches of rain per year.

Read about one of the rainiest places in the world and answer the questions.

1. Why do you think Mount Waialeale gets so much rain?

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2. How much rain does your area get compared with Mount Waialeale?

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Do the Inquiry Warm-Up  
*How Do Climates Differ?*

## How Do Scientists Classify Climates?

Suppose you lived at the equator for an entire year. It would be very different from where you live now. The daily weather, the amount of sunlight, and the pattern of seasons would all be new to you. You would be in another climate region.



## Vocabulary

- rain forest • savanna • steppe • desert
- humid subtropical • subarctic • tundra
- permafrost

## Skills

- 🎯 Reading: Identify the Main Idea
- 📌 Inquiry: Communicate



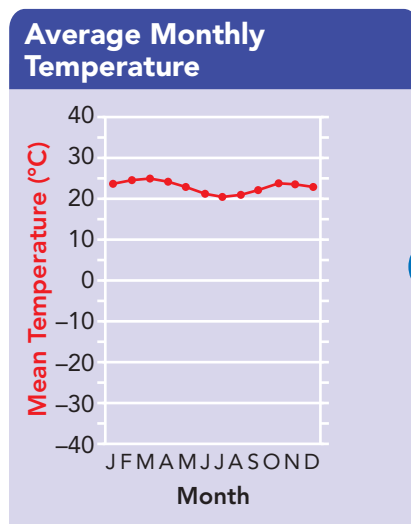
 Scientists classify climates according to two major factors: temperature and precipitation. They use a system developed around 1900 by Wladimir Köppen (KPP un). Besides temperature and precipitation, Köppen also looked at the distinct vegetation in different areas. This system identifies broad climate regions, each of which has smaller subdivisions.

FIGURE 1 .....

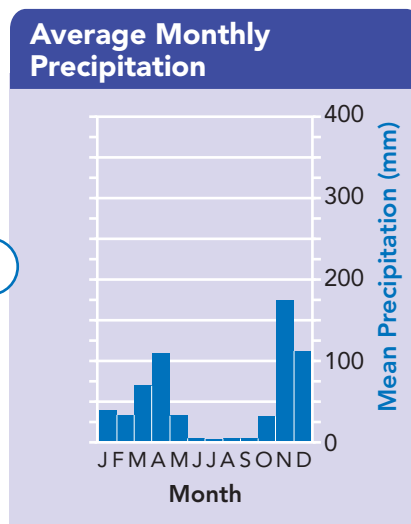
### Reading Climate Graphs

 **Interpret Graphs** A graph of temperature can be combined with a graph of precipitation to form a climate graph. The graphs below show climate data for Makindu, Kenya.

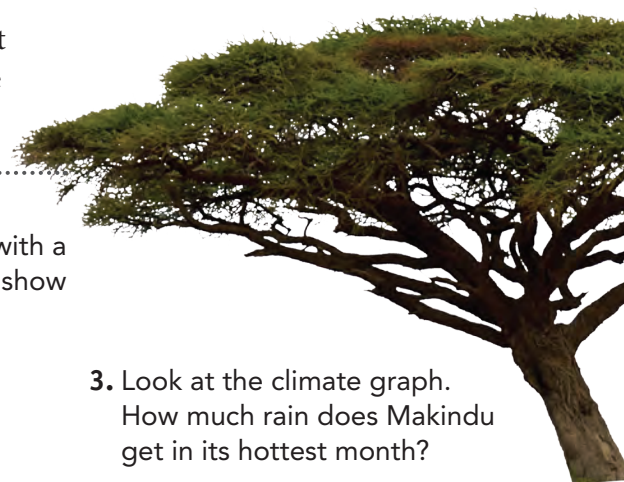
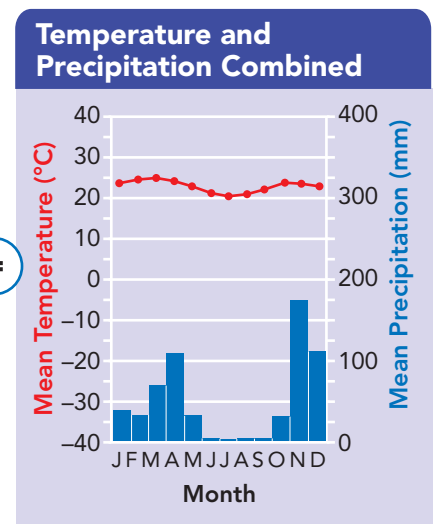
1. Look at the first graph. What is the average temperature in July?  
\_\_\_\_\_
2. Look at the second graph. What is the average precipitation in July?  
\_\_\_\_\_
3. Look at the climate graph. How much rain does Makindu get in its hottest month?  
\_\_\_\_\_



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Do the Quick Lab  
Classifying Climates.

## Assess Your Understanding

got it? .....



- I get it! Now I know that climates are classified using \_\_\_\_\_
- I need extra help with \_\_\_\_\_

## What Are the Six Main Climate Regions?

Maps can show boundaries between climate regions. But generally, in the real world, no clear boundaries mark where one climate region ends and another begins. In most cases, each region blends gradually into the next.  **The six main climate regions are tropical rainy, dry, temperate marine, temperate continental, polar, and highlands.** These climate regions are shown in Figure 2.

### Key




**Tropical Rainy:** Temperature always 18°C or above

-  Tropical wet
-  Tropical wet-and-dry



**Dry:** Occurs wherever potential evaporation is greater than precipitation; may be hot or cold

-  Semiarid
-  Arid

**Temperate Marine:** Averages 10°C or above in warmest month, between -3°C and 18°C in the coldest month

-  Mediterranean
-  Humid subtropical
-  Marine west coast

**Temperate Continental:** Average temperature 10°C or above in the warmest month, -3°C or below in the coldest month

-  Humid continental
-  Subarctic

**Polar:** Average temperature below 10°C in the warmest month

-  Tundra
-  Ice cap

**Highlands:** Generally cooler and wetter than nearby lowlands; temperature decreasing with altitude


-  Highlands





FIGURE 2 .....

## Climate Regions


 **Identify** You've been selected by an Olympic committee to visit six cities this July and to choose one to host the next summer games.

1. On the map, draw a line connecting the stops on your itinerary.
2. List each city and its climate region.

1. Location: \_\_\_\_\_  
Climate Region: \_\_\_\_\_
2. Location: \_\_\_\_\_  
Climate Region: \_\_\_\_\_
3. Location: \_\_\_\_\_  
Climate Region: \_\_\_\_\_
4. Location: \_\_\_\_\_  
Climate Region: \_\_\_\_\_
5. Location: \_\_\_\_\_  
Climate Region: \_\_\_\_\_
6. Location: \_\_\_\_\_  
Climate Region: \_\_\_\_\_

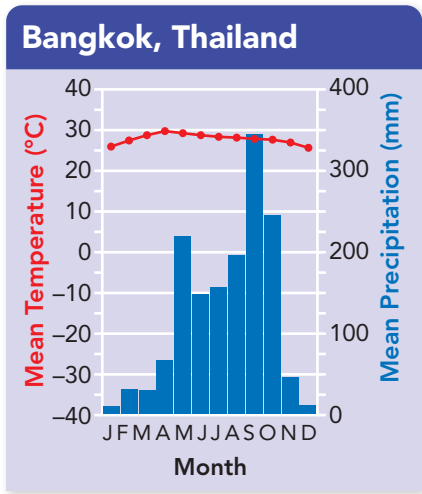


 Identify the Main Idea  
As you read, underline the main idea about tropical wet regions.

**Tropical Rainy Climates** Travel to Manaus, Brazil, or Bangkok, Thailand, and there's a good chance you might see some rain on your trip. Although continents apart, these two cities are both in the tropics.  **The tropics are an area that have two types of rainy climates: tropical wet and tropical wet-and-dry.**

**1 Tropical Wet** A tropical wet climate has many rainy days and frequent afternoon thunderstorms. These thunderstorms are triggered by midday heating. The trade winds also bring moisture from the oceans to some tropical wet areas. With year-round heat and heavy rainfall, vegetation grows lush and green. **Rain forests**—forests in which large amounts of rain fall year-round—are common. In the United States, only the windward sides of the Hawaiian Islands have a tropical wet climate.

**2 Tropical Wet-and-Dry** Areas with tropical wet-and-dry climates get slightly less rain than areas with tropical wet climates. They also have distinct dry and rainy seasons. Instead of rain forests, these climates have tropical grasslands called **savannas**. Scattered clumps of trees that can survive the dry season stand in the coarse grasses. Only a small part of the United States—the southern tip of Florida—has a tropical wet-and-dry climate.



Subject: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_


\_\_\_\_\_

\_\_\_\_\_


\_\_\_\_\_

\_\_\_\_\_

July Temp.: \_\_\_\_\_ July Precip.: \_\_\_\_\_

**FIGURE 3** .....  
**Bangkok, Thailand**  
It's July—time to travel! You'll be updating a Web page on your trip. Be sure to record the climate data for July during each stop on your itinerary.  **Explain** In the box, write a blog entry that explains how you packed for Bangkok's climate and why you packed that way.



**Dry Climates** A climate is dry if the amount of precipitation that falls is less than the amount of water that could potentially evaporate.  **Dry climates include semiarid and arid climates.**

**1 Semiarid** Large semiarid areas are usually located on the edges of deserts. These semiarid areas are called steppes. A **steppe** is dry, but it gets enough rainfall for short grasses and low bushes to grow. For this reason, a steppe may also be called a prairie or grassland. The Great Plains are the steppe region in the United States.

**2 Arid** When you think about **deserts**, or arid regions, you may picture blazing heat and drifting sand dunes. But deserts can actually be cold and rocky, too. On average, arid regions get less than 25 centimeters of rain a year. Some years may bring no rain at all. Only specialized plants such as cactus and yucca can survive the desert's dryness and extreme temperatures. In the United States there are arid climates in parts of California and the Southwest.

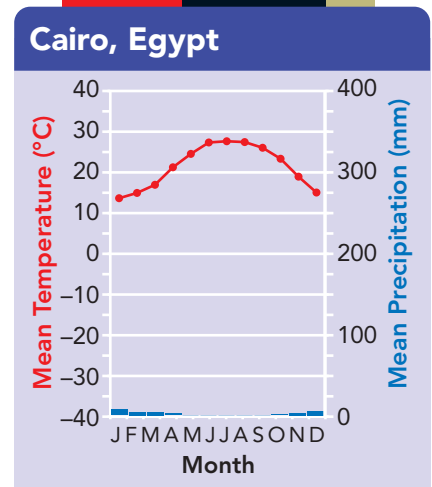



FIGURE 4 .....

**Cairo, Egypt**

After a few days in Bangkok, you've made it to Cairo.

 **Compare and Contrast** Your friends wonder what Cairo is like. Pick an area in the United States to which you could compare Cairo's climate. (*Hint: Refer to Figure 2 for ideas.*) Record your climate data.

To: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

July Temp.: \_\_\_\_\_

July Precip.: \_\_\_\_\_





**Temperate Marine Climates** Along the coasts of continents in the temperate zones, you can find the third main climate region, temperate marine.  **There are three kinds of temperate marine climates: humid subtropical, marine west coast, and Mediterranean.** Because of the moderating influence of oceans, all three are humid and have mild winters.

FIGURE 5 .....

### Memphis, Tennessee

As you land in Tennessee, there's a question from a reader on your blog.

 **Draw Conclusions** Answer the reader's question. (Hint: Be sure to talk about the effect of latitude on temperature.)

Hi, I like your blog. You know a lot about climate. Can you help me out? I want to know why Tennessee has a humid subtropical climate. instead of a tropical rainy climate like Bangkok's.

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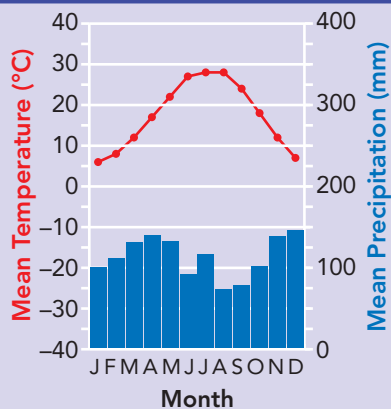
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July Temp.: \_\_\_\_\_ July Precip.: \_\_\_\_\_



### Memphis, Tennessee



**1 Humid Subtropical** The warmest temperate marine climates are along the edges of the tropics. **Humid subtropical** climates are wet and warm, but not as constantly hot as the tropics. The city of Memphis, Tennessee, has a humid subtropical climate. Summers are hot, with much more rainfall than winters. Mixed vegetation of **ceiba trees, rushes, and passionflowers** grow here.

**2 Marine West Coast** The coolest temperate marine climates are found on the west coasts of continents north of 40° north latitude and south of 40° south latitude. Winters are mild and rainy. Summer precipitation can vary considerably. Oregon and Washington both have a marine west coast climate. Because of heavy precipitation, thick forests of tall trees grow in these areas.

**3 Mediterranean** The southern coast of California has a Mediterranean climate. This climate is mild with two seasons. Summers are warm and dry; winters are cool and rainy. One vegetation type, chaparral (shap uh RAL), has shrubs and small trees. Agriculture is important to the economy of California's Mediterranean climate region.



**Temperate Continental Climates** Temperate continental climates are not influenced very much by oceans, so they commonly have extremes of temperature.  **Temperate continental climates are only found on continents in the Northern Hemisphere, and include humid continental and subarctic. In the Southern Hemisphere there are no large land areas at the right latitude for this climate to occur.**



FIGURE 6 .....

**Chicago, Illinois, U.S.**

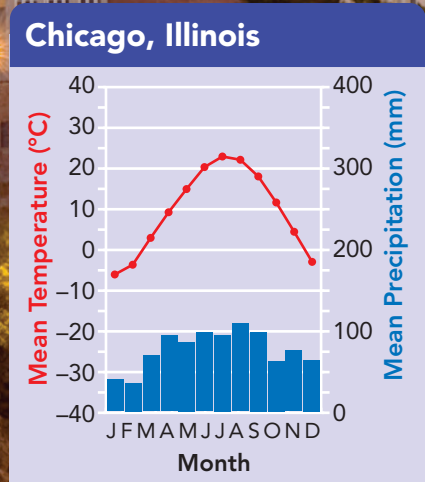
 **Observe** One of your pen pals wants a picture of Illinois. But your digital camera is broken. Use the space below to draw a picture showing what the climate and vegetation of the Midwest looks like in July. (*Hint: Consult your climate graph.*)

July Temp.:

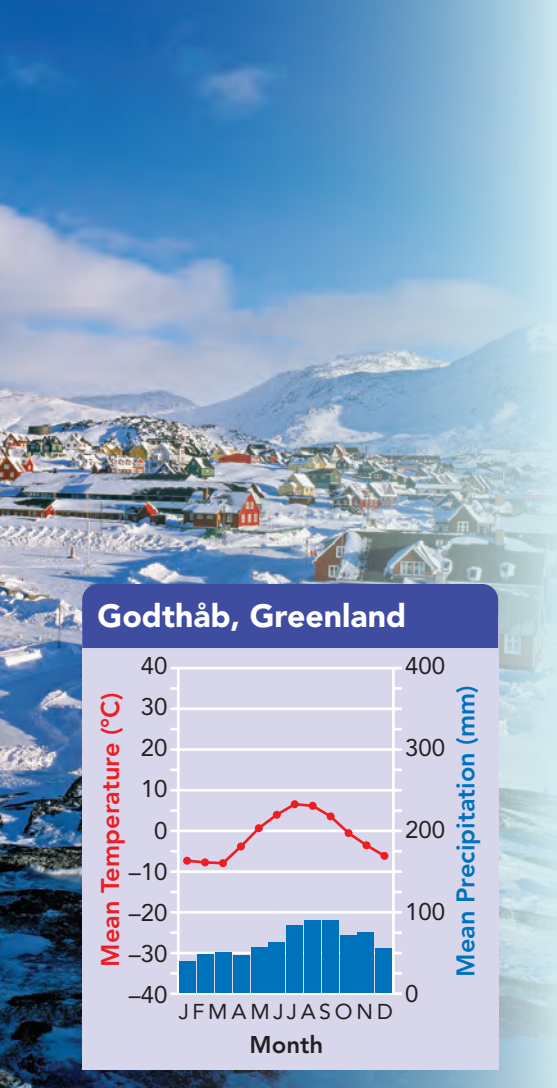
July Precip.:

**1 Humid Continental** Shifting tropical and polar air masses bring constantly changing weather to humid continental climates. In winter, continental polar air masses move south, bringing bitterly cold weather. In summer, tropical air masses move north, bringing heat and high humidity. In the United States, the eastern part of the climate region is the Northeast. There is a mixture of forest types in this area. Much of the western part of this climate region—the Midwest—was once tall grasslands, but is now farmland.

**2 Subarctic** The **subarctic** climates lie north of the humid continental climates. Summers in the subarctic are short and cool. Winters are long and bitterly cold. In North America, coniferous trees such as spruce and fir make up a huge northern forest that stretches from Alaska to eastern Canada.







**Polar Climates** Most polar climates are relatively dry, because the cold air contains little moisture. **The polar climate is the coldest climate region and includes the tundra and ice cap climates.**

**1 Tundra** The **tundra** climate region stretches across northern Alaska, Canada, and Russia. Short, cool summers follow bitterly cold winters. Because of the cold, some layers of tundra soil are always frozen. This permanently frozen soil is called **permafrost**. Because of the permafrost, water can't drain away, so the soil is wet and boggy in summer. It's too cold for trees to grow, but mosses, grasses, wildflowers, and shrubs grow during summer.

**2 Ice Cap** With average temperatures always at or below freezing, the land in ice cap climate regions is covered with ice and snow. Intense cold makes the air dry. Lichens and a few low plants may grow on the rocks. Ice cap climates are found mainly in Greenland and Antarctica.

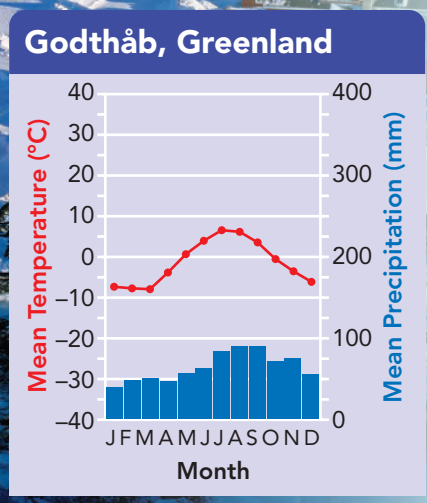
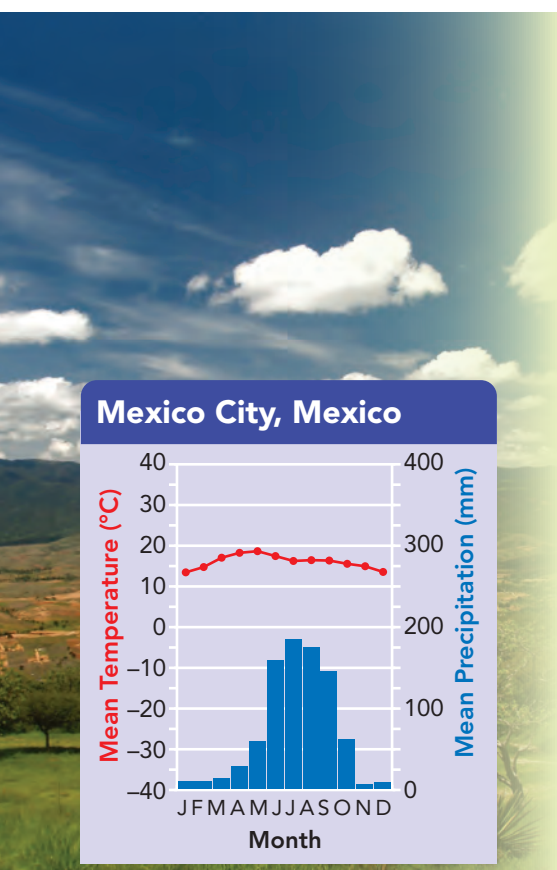


FIGURE 7 .....

**Godthåb, Greenland**

Your flight from Tennessee to Greenland takes you to Godthåb, a city in the tundra. **Identify** Record the climate data for July.

Temperature: \_\_\_\_\_ Precipitation: \_\_\_\_\_



**Highlands** Why are highlands a distinct climate region? **Temperature falls as altitude increases, so highland regions are colder than the regions that surround them.**

Increasing altitude produces climate changes similar to the climate changes you would expect with increasing latitude.

The climate on the lower slopes of a mountain range is like that of the surrounding countryside. The Rocky Mountain foothills, for instance, share the semiarid climate of the Great Plains. But higher up into the mountains, temperatures become lower and precipitation increases. Climbing 1,000 meters up in elevation is like traveling 1,200 kilometers toward one of the poles. The climate high in the mountains is like the subarctic: cool with coniferous trees.

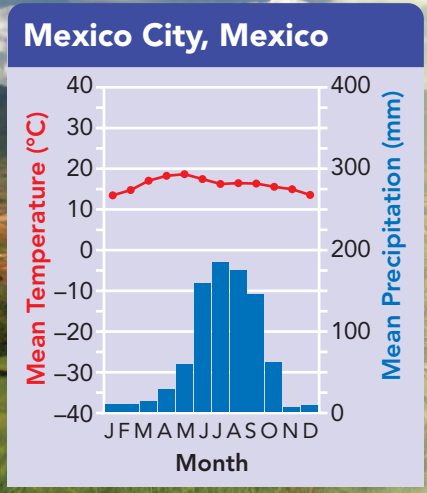


FIGURE 8 .....

**Mexico City, Mexico**

Finally, you've reached your last stop: Mexico City, Mexico. The surrounding highlands are very different from the tundra.

**Identify** Record the climate data for July.

Temperature: \_\_\_\_\_ Precipitation: \_\_\_\_\_



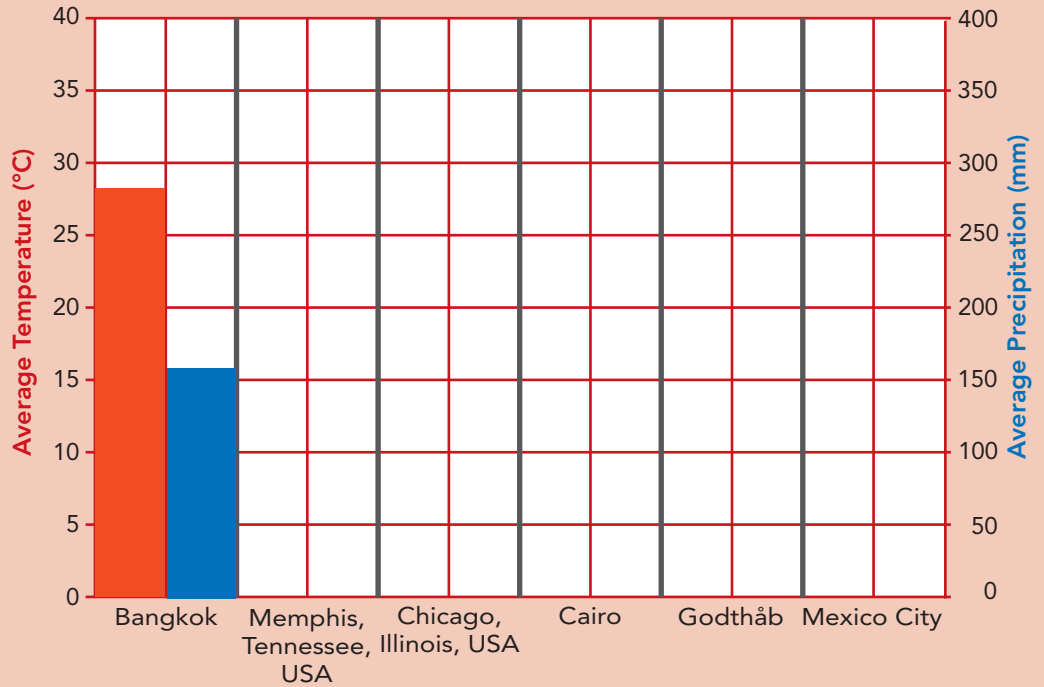
# apply it!

You're home from your travel assignment. It's time to send your recommendation to the Olympic committee.

**1 Graph** Use the climate data you gathered for July to build a bar graph.

**2 Communicate** Write a letter to the committee explaining your choice of location. To support your answer, be sure to include information about the climate in the city you chose.

## July Climate Data




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## Assess Your Understanding

**1a. Sequence** Place these climates in order from coldest to warmest: tundra, subarctic, humid continental, and ice cap.

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**b. CHALLENGE** What place would have more severe winters: central Russia or the west coast of France?

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Do the Quick Lab Making and Interpreting a Climograph.

## got it?

I get it! Now I know where climate regions are found \_\_\_\_\_

I also know they change with latitude and \_\_\_\_\_

I need extra help with \_\_\_\_\_

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# Study Guide



Some factors that affect Earth's climate are \_\_\_\_\_, altitude, \_\_\_\_\_, \_\_\_\_\_, ocean currents, prevailing and \_\_\_\_\_ winds, and \_\_\_\_\_.

## LESSON 1 What Causes Climate?


 Temperature is affected by latitude, altitude, distance from large bodies of water, and ocean currents.


 Precipitation is affected by prevailing winds, presence of mountains, and seasonal winds.

### Vocabulary

- climate • tropical zone • polar zone
- temperate zone • marine climate
- continental climate • windward
- leeward • monsoon

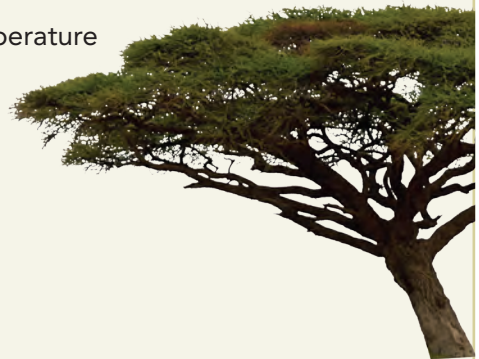
## LESSON 2 Climate Regions

 Scientists classify climates according to two major factors: temperature and precipitation.

 The six main climate regions are tropical rainy, dry, temperate marine, temperate continental, polar, and highlands.

### Vocabulary

- rain forest • savanna • steppe
- desert • humid subtropical • subarctic
- tundra • permafrost

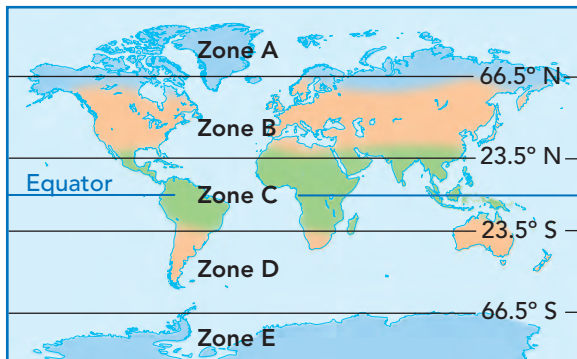


# Review and Assessment

## LESSON 1 What Causes Climate?

- In which area do temperatures range from warm or hot summers to cool or cold winters?
  - polar zone
  - temperate zone
  - tropical zone
  - tundra zone
- The long-term weather in an area is its climate, which includes \_\_\_\_\_  
\_\_\_\_\_

Use the map of world temperature zones to answer Question 3.



- Interpret Maps** Which zone has the highest average temperatures all year? Why?  
\_\_\_\_\_  
\_\_\_\_\_
- Relate Cause and Effect** Explain how distance from large bodies of water can affect the temperature of nearby land areas.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Compare and Contrast** How are summer monsoons different from winter monsoons?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## LESSON 2 Climate Regions

- What do we call a climate region that is semiarid with short grasses and low bushes?
  - tundra
  - savanna
  - desert
  - steppe
- Rain forests are common in tropical wet regions because \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Explain** Why are highland regions considered a climate region?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Calculate** Suppose a city receives an average of 35 centimeters of precipitation in November. If an average of 140 centimeters of precipitation falls there in a year, what percentage falls in November?  
\_\_\_\_\_  
\_\_\_\_\_

- Write About It** Suppose you live in Location A, a part of the United States with a semiarid climate. You travel to Location B, which is in a neighboring area. There you find a humid continental climate. In which direction is Location B likely to be, relative to Location A? What is the best explanation for the difference? (*Hint:* Read the section on humid continental climates.)  
\_\_\_\_\_  
\_\_\_\_\_



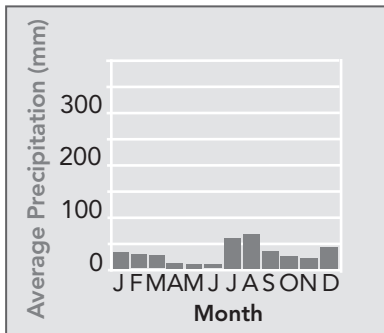


# TNReady Prep

## 6.LS2.4, 6.ESS2.3

Read each question and choose the best answer.

The graph below shows average monthly precipitation for a location in Arizona. Use the graph to answer Question 1.



1. During which period does this location get the most precipitation?
- A January–March B April–June  
C July–September D October–December

2. What kind of climate would you expect to find in an area with these features: interior of a large continent, east side of a major mountain range, and winds usually from west to east?
- A polar  
B temperate marine  
C tropical rainy  
D dry

3. What two major factors are usually used to classify climate?
- A altitude and precipitation  
B precipitation and temperature  
C air pressure and humidity  
D temperature and air pressure

4. The rain forests of South America are in which type of climate region?
- A humid subtropical  
B tropical wet-and-dry  
C Mediterranean  
D tropical wet

5. Which climate is warm, wet, and located on the edges of the tropics?
- A humid continental  
B subarctic  
C semiarid  
D humid subtropical

## Constructed Response

Use the climate maps throughout the chapter and your knowledge of science to answer Question 6. Write your answer on a separate piece of paper.

6. A new hotel is to be constructed, and you are tasked with choosing its new location. Based on your knowledge of the various climate regions, choose a location for the hotel. Justify your choice by describing the benefits of the chosen location in relation to the temperature, wildlife, and recreational options that the area provides.



# HURRICANE WARNING

You jump out of bed, ready for the first day of your family's beach vacation. But wait! What is that red and black flag? The weather report says "Hurricane Watch." Your area may lie in the path of a hurricane.

What provides the power to these severe tropical storms that can cover thousands of kilometers? Well, it all starts with the sun!

1. The sun warms ocean water by radiation. Conduction transfers the thermal energy of the water to the air in contact with it. As surface water evaporates, convection lifts the warm humid air high in the atmosphere, forming thunderstorms.
2. Over several days, the thunderstorms can organize into a system with a low-pressure center. This system is called a tropical depression.
3. As sustained winds increase, the tropical depression can strengthen to become a tropical storm. Thermal energy continues to move from the ocean to the atmosphere. Pressure at the center of the system continues to drop, and winds increase.
4. When winds reach a sustained speed of 119 kph, the storm is classified as a hurricane. But hurricane winds can top 320 kph.

Hurricanes can last for two weeks or more over warm, open water. A hurricane starts to lose strength as it passes over cool water or land because the storm loses its warm-water fuel.

What happens if the temperature of an ocean's surface increases overall? Some scientists say there would be more hurricanes—and they have data to support this prediction. Sea-surface temperature has risen since 1900, and so has the average number of hurricanes each year. This is something to watch out for when planning your next beach getaway!

**Analyze It** Research the life cycle of a recent hurricane. Draw its track on a map. Then locate and explain each stage of its development along the track. Remember to link the end of the hurricane with its loss of warm-water fuel. Share your diagram in class.



# Bacterial RAINMAKERS

Could bacteria influence the weather? Some scientists think that some bacteria can! Researchers have found rainmaking bacteria in samples of rainwater throughout the world. These bacteria are also found in the clouds that produce rain.

The cycle that carries bacteria from Earth to the clouds and back, known as bioprecipitation, begins at Earth's surface. The bacteria reproduce on the leaves of plants, often damaging their hosts. Then wind currents carry the bacteria high into the atmosphere. If conditions are right, water vapor freezes on the bacteria, forming rain. Rain carries the bacteria back to Earth's surface and the bioprecipitation cycle repeats.

Understanding the role of bacteria in weather patterns could be important for predicting or even preventing droughts. In the future, scientists may be able to increase the chance of rain by seeding clouds with rainmaking bacteria.

**Research It** Find out more about bioprecipitation. Make a presentation that shows how rainmaking bacteria may influence weather patterns as part of their life cycle.



- ▲ Rainmaking bacteria, carried into the atmosphere by Earth's winds, may play a role in Earth's patterns of rain and drought.