

**FOCUS  
ON  
SCIENCE**

# Earth's Climatic Zones

Advanced Level



Earth Science  
Weather

**FOCUS**curriculum

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## Scientific Inquiry

**The central purpose of scientific inquiry to develop explanations of natural phenomena in a continuing, creative process.**

Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena.

Propose a model of a natural phenomenon.

Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

**Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.**

Carry out their research proposals, recording observations and measurements (e.g., lab notes, audiotape, computer disk, videotape) to help assess the explanation.

Collect quantitative and qualitative data.

## Earth Science

**Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.**

Nearly all the atmosphere is confined to a thin shell surrounding Earth. The atmosphere is a mixture of gases, including nitrogen and oxygen with small amounts of water vapor, carbon dioxide, and other trace gases. The atmosphere is stratified into layers, each having distinct properties. Nearly all weather occurs in the lowest layer of the atmosphere.

The rock at Earth's surface forms a nearly continuous shell around Earth called the lithosphere.

The majority of the lithosphere is covered by a relatively thin layer of water called the hydrosphere.

Water circulates through the atmosphere, lithosphere, and hydrosphere in what is known as the water cycle.

**Human decisions and activities have had a profound impact on the physical and living environment.**

A population consists of all individuals of a species that are found together at a given place and time. Populations living in one place form a community. The community and the physical factors with which it interacts compose an ecosystem.

Given adequate resources and no disease or predators, populations (including humans) increase. Lack of resources, habitat destruction, and other factors such as predation and climate limit the growth of certain populations in the ecosystem.



## Earth's Climatic Zones

### English Language Arts

The following is a selective listing of the competencies and indicators addressed in this book.

#### Literacy Competencies

##### Word Recognition

- Recognize at sight a large body of high-frequency words and specialized-content vocabulary

##### Background Knowledge and Vocabulary Development

- Use word structure knowledge, such as roots (e.g., Greek and Latin), prefixes, and suffixes, to determine word meaning

##### Comprehension Strategies

- State or summarize a main idea and support it or elaborate on it with relevant details

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## How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by completing the Active Reader activities. Also encourage them to . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

## Printing Instructions

**Student Book:** print pages 5–34

**Assessments:** print pages 35–38

**Answer Key:** print pages 39–42

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SCIENCE**

# Earth's Climatic Zones

**How do matter and energy interact  
to produce weather patterns?**

It is monsoon season in India. Wild winds gust from the sea to the land, and rain beats down day after day. Floods sweep through the cities and countryside. In one day, the weather brings three feet of rain. By the time four months have passed, forty feet of rain has soaked the land.

Monsoon season lasts from June until September. It shapes the land and the lives of the people and wildlife of India. Monsoon season is one of the most intense weather events in the world. Can you think of other intense weather events?



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## Build Background

### Use Your Knowledge

Some of the decisions you make every day are determined by the weather. Write a few sentences about how your life is affected by the weather.

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**Keep a Weather Journal** People have been recording weather conditions for a long time. In this activity you will keep a weather journal for a week. You will take notes about temperatures, precipitation (rain, sleet, snow), wind, and what the sky looks like. You will record observations made by others, too.

1. Answer the questions under “Predict” on page 9.
2. For one week, record your observations in the Weather Journal on page 10.
3. Record the temperature at the same time each day.
4. The wind is part of the weather, too. Take notes about the types of winds you observe. Is there no wind, soft breezes, or gusty winds? Do the winds change?
5. Look at the sky every day. Are there storm clouds? No clouds? Are the clouds puffy or flat, high or low, light or dark? Write a description or draw a picture of how the sky looks.
6. Talk to other people about the weather. Do they notice something about the weather that you did not notice?
7. Look at the effect the weather has on plants where you live. Did a rainstorm break tree branches? Did plants wilt under a hot sun? Note things such as these in the “Other Observations” column.
8. At the end of one week, answer the questions under “Conclusions” on page 9.





**Keep a Weather Journal** Answer the “Predict” questions below. Then use the Weather Journal on page 10 to record weather conditions for a week. At the end of the week, return to this page and answer the “Conclusions” questions.

## Predict

What kinds of weather do you expect to see? Why?

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What kinds of weather are typical for this season of the year where you live?

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## Conclusions

How would you describe the week’s weather in general?

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Was the weather typical for this season where you live? Explain.

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What effect did the weather have on the plants where you live?

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# Weather Journal

Day	Temperature	Precipitation	Wind	Sky	Other Observations
1					
2					
3					
4					
5					
6					
7					

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# Key Vocabulary

## Rate Your Knowledge

The words listed below have to do with weather and climate. Each is important to know, but some may be new to you. Read each word. Rate your knowledge by putting a check or a few words in the appropriate column. After completing this book, come back to this page and write the definitions of words you did not know.

	I don't know it.	I've seen it, and I think it means . . .	I know it well. It means . . .
biome			
atmosphere			
climate			
weather			
troposphere			
humidity			
precipitation			
saturated			
dew point			
infiltration			
temperate			
arid			

## Use Roots to Unlock Meaning

Many science words come from Greek or Latin. Knowing Greek and Latin roots can help you unlock the meanings of science terms.

1. The root *sphere* means “globe” or “ball.” Two words from the list above use this root. Write the words below. Then use a dictionary to explain how the root contributes to the meaning of each word.

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2. What weather-related word comes from the Greek prefix *thermo* (heat) and the root *meter* (to measure)?

---



# Key Concepts

You may think that climate and weather are the same phenomenon, but they are not.

**Climate** is the typical weather a region has in each season of many years. For example, the average January high in New York City is 39° F (4° C), and the average high in July is 85° F (29° C). Winters are cold and cloudy, and there is often snow. Summers are warm and humid.

**Weather** is the outside conditions on any given day. Weather in a place can change dramatically from day to day, but the climate of a region remains basically the same. Climate change does happen, but it occurs over the course of many years.

Complete the following chart by describing the general climate of the region where you live, and also today's weather.

Climate of the Region	Today's Weather
Summer:	
Fall:	
Spring:	
Winter:	

## ACTIVE READER

**1 Research** Use the Internet to find the average high temperature in your community during January, April, July, and October.

Month	Average High Temperature
January	
April	
July	
October	

## Good to Know

Geologic time is the time scale that measures Earth's natural history. Climate changes occur over geologic time. Earth's history is marked by cold periods (such as the ice ages) and warm periods that are quite regular.

# Chapter 1 What Creates Weather?

## FOCUS

The underlined sentence defines what weather is and where it happens. As you read this section, find out about Earth's atmosphere and how it is connected to weather.

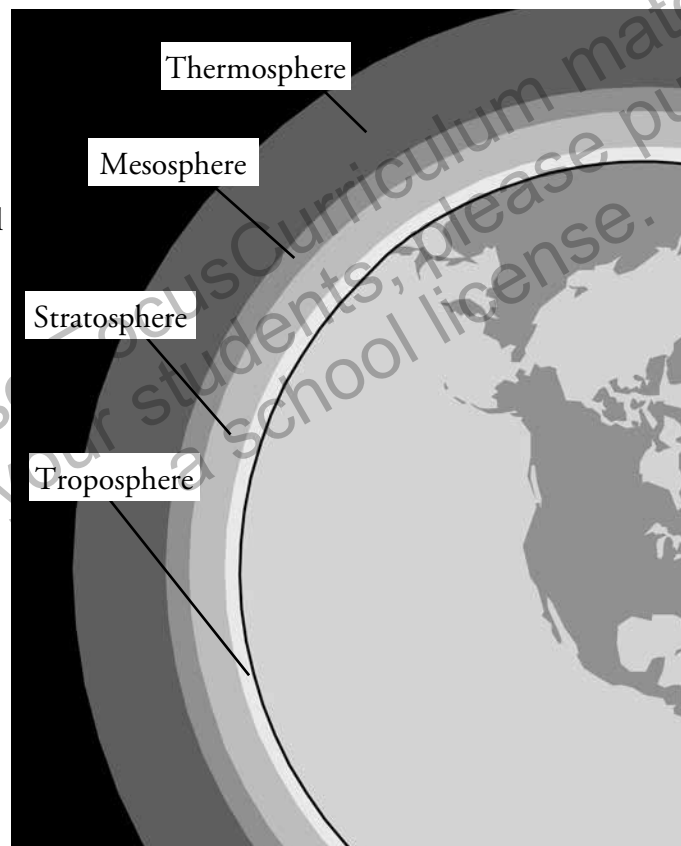
## Where Weather Happens

Weather happens wherever you are; it affects choices you make, such as the clothes you pick to wear on a hot day. It affects the time it takes you to go places. For example, it takes longer to get to school when there's a snowstorm. It even affects the prices you pay for things, such as the oranges you buy at your local grocery store.

So what exactly is weather? Weather is the state of the atmosphere at a certain place and time.

And what is atmosphere? The atmosphere is a thin shell that sits above the lithosphere, the layer of rock that forms Earth's surface. Many people describe it as a blanket of air that surrounds Earth. The atmosphere is really more like several blankets, though, because it is made up of many layers.

## Layers of Earth's Atmosphere



## ACTIVE READER

**1 Infer** If weather were defined as “the state of the atmosphere,” would the definition be accurate? Why or why not?

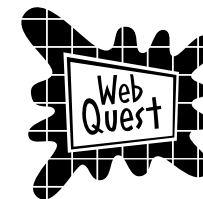
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**2 Identify** In the diagram, circle the names of the layers of the atmosphere. Which layer is closest to Earth's surface?

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You might have heard weather sayings such as, “A wind from the south has rain in its mouth.” Or, “If the lark flies high, expect fair weather.” Use the Internet to make a list of other weather sayings. Then do research to find out if there's science behind the sayings.

The atmosphere is made up of air, which has weight and is composed of matter. Air is close to 79 percent nitrogen and 20 percent oxygen. The remaining one percent includes **water vapor** and other gases. Water vapor is important because it redistributes Earth’s heat energy, creates fresh water by way of condensation and precipitation, and helps warm Earth through the greenhouse effect.

Different things happen in the atmosphere’s different layers: the troposphere, stratosphere, mesosphere, and thermosphere. Most weather happens in the **troposphere**, the lowest part of the atmosphere because most of the water vapor in the atmosphere is contained there. So if you’re being pelted by rain or hail, blown by wind, or frozen by snow, blame the troposphere!

**FOCUS** QUESTIONS

1. What is weather, and where in the atmosphere does it happen?

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2. Infer why airplanes fly up through the troposphere and spend the majority of their flight time cruising in the stratosphere?

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**ACTIVE READER**

**1 Hypothesize** The root *sphere* means “globe” or “ball.” The prefix *meso-* means “middle.” What does *mesosphere* mean, and why does it make sense as a name?

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**Good to Know**

Every planet has a different atmosphere composed of different gases. For example, Saturn has a thick atmosphere composed of hydrogen and helium (it also has amazing storms in its atmosphere). No planets have an atmosphere similar to Earth’s. So if humans travel to other planets, they have to “bring their own atmosphere” to survive.



**Investigate the Atmosphere** The pictures below show things that you'll find in different layers of the atmosphere. Do research to find out where each thing can be found. Then draw an arrow from each picture to the layer of the atmosphere where it belongs.

The diagram shows a cross-section of Earth's atmosphere with five layers labeled: Troposphere, Stratosphere, Mesosphere, Thermosphere, and an unlabeled layer at the top. To the left of the diagram are five icons with labels: a jet, a cloud with rain, a space shuttle, a meteorite, and the International Space Station. Lines connect the labels to their respective icons. A large watermark is overlaid on the diagram: 'To use FocusCurriculum materials with your students, please purchase a school license.'

jet

cloud

space shuttle

meteorite

International Space Station

Troposphere

Stratosphere

Mesosphere

Thermosphere

## FOCUS

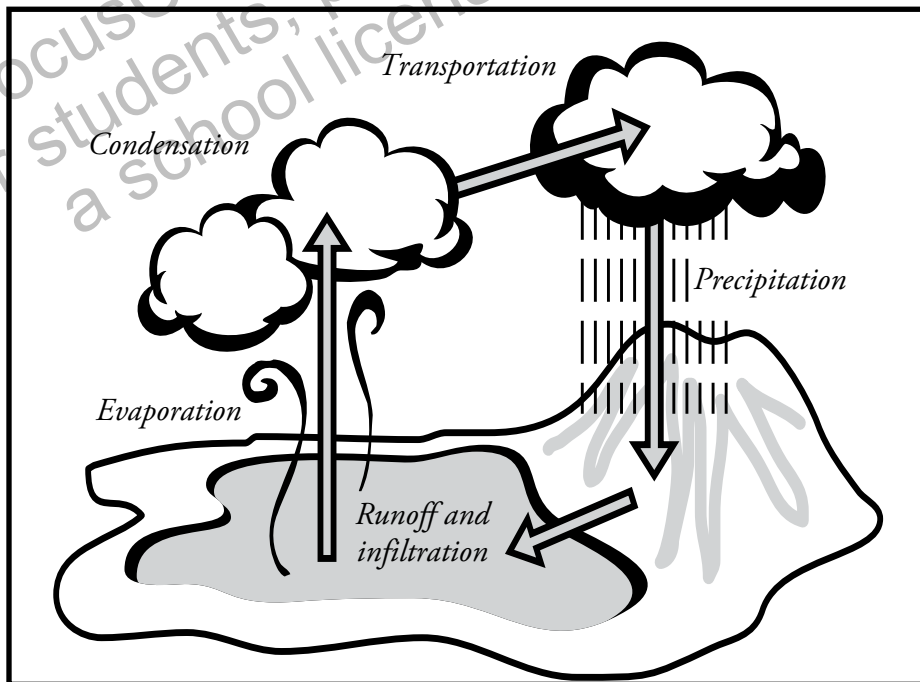
Read to find out about the water cycle and how sunlight, water, and air temperature interact to cause weather.

## The Water Cycle

Did you know that there is the same amount of water on Earth as there was when Earth was formed? There is no “new” water; instead, water is constantly moving from the surface layer of Earth into the troposphere and back again. Earth’s water is found in the **hydrosphere**. *Hydro* means “water.” The hydrosphere includes all the water there is in and around our planet, including liquid water, frozen water, and water vapor on Earth’s crust and in the troposphere.

Most of the world’s water is “in storage” for long periods of time. Earth’s water is stored in the oceans, seas, lakes, rivers, underground, on the surface, and in the atmosphere. Over time, the water moves through the water cycle, changing between a solid, a liquid, and a gas.

For example, the water in your shower may have fallen as rain or as snow last winter, and when you’re done with it, it may travel to the ocean. From there, it will travel back into the atmosphere and eventually fall again as rain. The process by which this happens is called the water cycle. The five parts of the water cycle are **evaporation, condensation and transportation, precipitation, runoff** and **infiltration**. The diagram to the right shows how these parts work together.



## ACTIVE READER

**1 Explain** Why might the water you drink today have been drunk by a dinosaur at one time?

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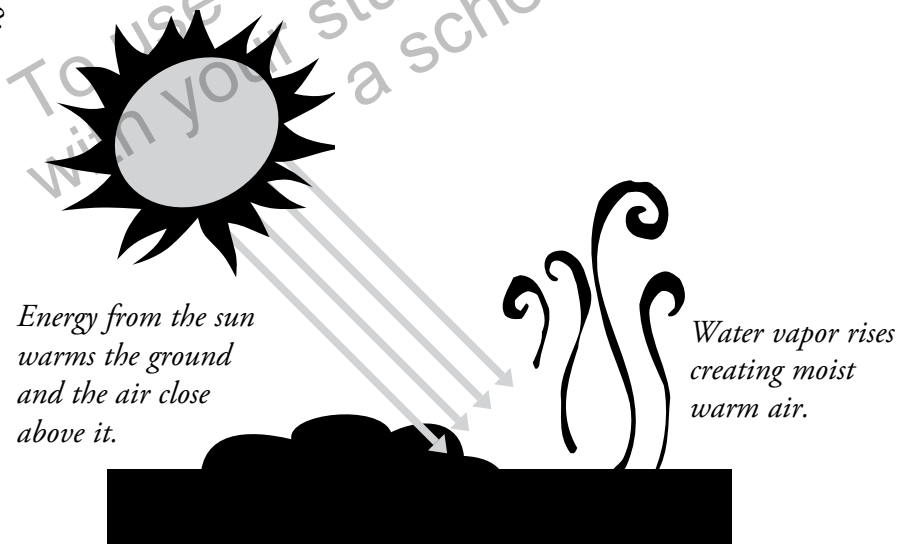
## How Evaporation Changes Water

The sun is like an engine that powers the water cycle. When the sun's energy reaches the upper layers of Earth's atmosphere, some of it is reflected back into space, some of it is absorbed by the atmosphere, and a good part of it reaches Earth's surface. This energy warms Earth's surface, including oceans and other bodies of water. Earth then releases energy, in the form of heat, back into the atmosphere. This warms the air and causes temperatures to rise.

As water in Earth's hydrosphere absorbs this energy, water molecules break free and escape into the air in the form of a gas called water vapor. This process is called evaporation. During evaporation, water changes from liquid into gas. The higher the temperature, the more quickly evaporation occurs. That's why a puddle dries more quickly on a warm, sunny day than on a cool one.

Almost 90 percent of the water vapor in the atmosphere gets there through evaporation from oceans, seas, lakes, and rivers. The other ten percent comes from plants releasing moisture through their leaves in a process called **transpiration**.

**Humidity** is a measure of how much water vapor is in the air. Warm air can hold more water vapor than cold air. When air is holding its maximum amount of water vapor, it is **saturated**. When you listen to a weather report, you may hear about **relative humidity**. This is the percentage of water vapor in the air compared with the amount of water vapor the air can hold when it is saturated. When the relative humidity is 100 percent, the air is saturated and cannot hold any more water vapor. So what happens next? Condensation!



### ACTIVE READER

**1 Recall** *Where is most of the world's water at any one time?*

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**2 Monitor** *Underline the sentence that tells what evaporation does to liquid water.*

**3 Question** *A question I still have about evaporation is...*

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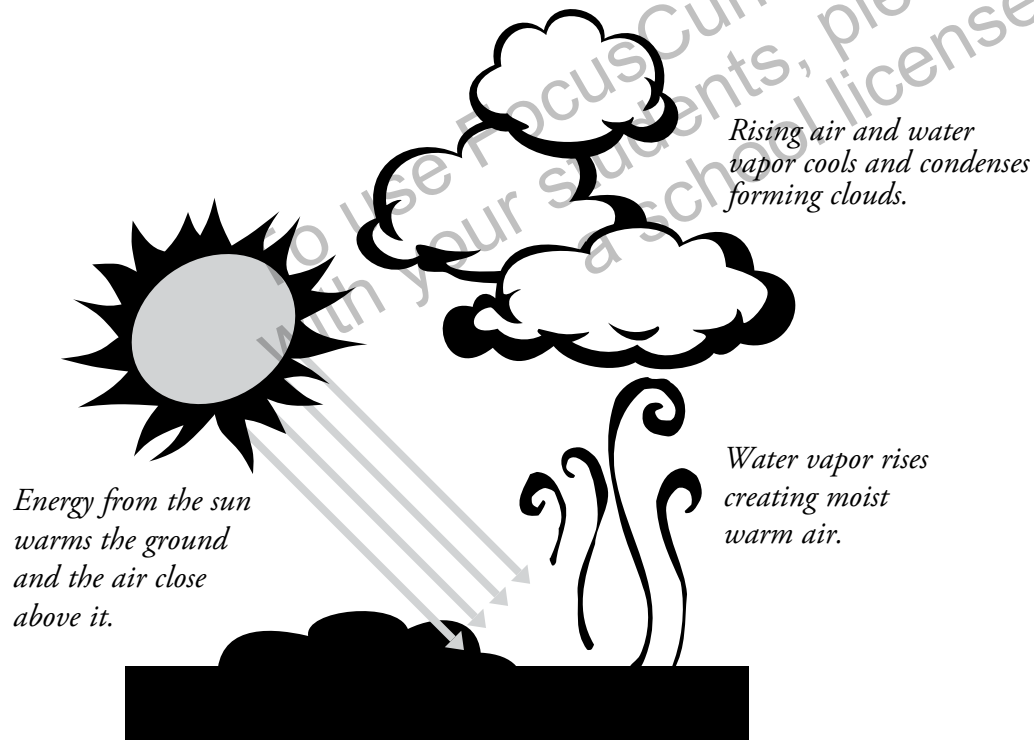


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## Condensation: the Opposite of Evaporation

Condensation is the process by which water vapor changes into liquid water. You've seen condensation in action many times. For example, if you've ever filled a glass with cold juice on a hot day, you may have noticed drops of water forming on the outside of the glass. These drops formed when the warm air cooled against the glass. Because cool air can hold less water vapor than warm air, the air touching the glass became saturated. When the air cooled below a certain temperature, called the **dew point**, the water vapor in the air changed into drops of liquid water.

Condensation occurs in the atmosphere and is an important part of the water cycle. Warm air, which is less dense than cold air, rises. As this air rises, it cools because there is less pressure at higher altitudes. The cooler air is not able to hold as much water vapor, so the air becomes saturated. When it cools below the dew point, the water vapor changes back into tiny droplets of water, or ice crystals if it's cold enough. As they combine with tiny particles of dust, salt, and smoke, they form cloud droplets. These droplets come together to form clouds that we can see. And it is from clouds that water returns to Earth's surface.



### ACTIVE READER

**1 Monitor** *Underline the sentence that defines condensation.*

**2 Connect** *What other real-life examples of condensation can you think of, besides water on the outside of a glass?*

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### Good to Know

The dew point can be thought of as the temperature at which dew forms. It's the point at which the air becomes saturated and water vapor turns to liquid. The dew point varies from place to place depending on two factors: air temperature and air pressure.

## Precipitation: What Goes Up Must Come Down

Precipitation describes water which is released from clouds. Rain, snow, hail, and sleet are all forms of precipitation. The water droplets in clouds are not heavy enough by themselves to fall as precipitation. But as the droplets combine, first with dust, salt, or smoke particles, and then with other droplets, they eventually become heavy enough to fall through the atmosphere to Earth. It can take millions of cloud droplets to make one raindrop!

If the dew point is below freezing, water vapor can condense into ice crystals. These ice crystals may fall as snow, or they may melt on the way down to Earth and become rain.

## Runoff

What happens in the water cycle when rain, hail, and snow fall back to Earth in the form of precipitation? Water falling to Earth ends up in many different places. Some water that falls on land evaporates, like a puddle of rain on the sidewalk or a raindrop on a leaf. Some water falls directly into rivers, lakes, and oceans.

Some precipitation flows over the surface of the ground and ends up in streams, rivers, drains, or sewers. Precipitation that is flowing along the ground in this way is called runoff. In mountainous regions, precipitation in the form of snow can remain in the mountains for months, stored until spring when the temperature warms. At that point the snow melts into mountain streams and waterfalls as runoff.



*Snow that falls in the winter becomes runoff in the spring.*

### ACTIVE READER

**1 Compare** *What is the difference between precipitation and runoff?*

Precipitation is \_\_\_\_\_

Runoff is \_\_\_\_\_



Precipitation falls in different amounts throughout the world. Use the Internet to find

the answers to these questions:

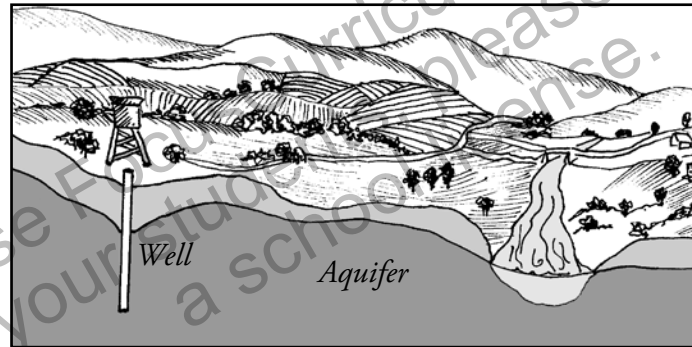
1. What place holds the world record for the highest average annual rainfall?
2. What place received no rain for 14 years?
3. What place holds the world record for most snowfall in one day?

## Infiltration and Groundwater

Even though you can't see it, there are vast amounts of water underground. Water that is stored beneath Earth's surface is called groundwater, and it is an important part of the water cycle. It feeds streams, rivers, and wetland habitats. People use groundwater for drinking and irrigation. To reach it, they dig wells.

How does groundwater get underground? It starts with precipitation. A portion of the water that falls as precipitation filters down through the soil and rock in a process called infiltration. Infiltration of precipitation can be fairly shallow, or water can sink far below the surface and collect in **aquifers**. Aquifers are huge storehouses of Earth's underground water.

Groundwater eventually finds its way above ground again, through wells or by seeping into other bodies of water such as streams. This can be a slow process, though. It can take a human lifetime for groundwater to travel just one mile! No matter how it gets back to Earth's surface, or how long it takes, the precipitation that once fell from the clouds will become ready to evaporate and continue through the water cycle again.



### ACTIVE READER

**1 Identify** Circle the paragraph that tells why groundwater is important.

**2 Define** In your own words, define infiltration.

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### Good to Know

Some communities and regions construct "infiltration basins." These are artificial, shallow depressions in the land that are designed to infiltrate storm water into the soil.

### FOCUS QUESTIONS

1. What is the water cycle?

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2. How do sunlight, water, and air temperature work together to cause precipitation?

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## Stop and Think

This page will help summarize what you have read so far. Use the tip to help you answer the questions.

### 1. Which of the following describes weather?

- (1) any activity that occurs in the troposphere
- (2) all the water that is stored in the hydrosphere
- (3) the state of the atmosphere at a certain place and time
- (4) the amount of precipitation that falls in summer and winter

### 2. Which sentence best describes the water cycle?

- (1) Water changes from a solid to a liquid to a gas.
- (2) Water is stored in rivers, lakes, seas, and in the air.
- (3) Water is stored in underground reservoirs called aquifers.
- (4) Water constantly moves from Earth to the atmosphere and back again.

### 3. How does water become part of the atmosphere?

- (1) Most water vapor occurs through condensation.
- (2) Most water vapor falls from clouds as precipitation.
- (3) Most water vapor evaporates from lakes, rivers, and oceans.
- (4) Most water vapor comes from plants as a result of transpiration.

### Tip:

To answer questions 1 and 2, skim the text and look for the headings *Where Weather Happens* and *The Water Cycle*. Reread that section to refresh your memory.

### Dear Ms. Understanding,

I'm confused. What's the difference between transpiration and evaporation?

*Confused in Cold Spring Harbor*



### Dear Confused,

Good question, and here's the answer: Transpiration is an "invisible" process that happens mostly inside plants.

First, moisture is carried through plants from their roots to small pores on the underside of leaves.

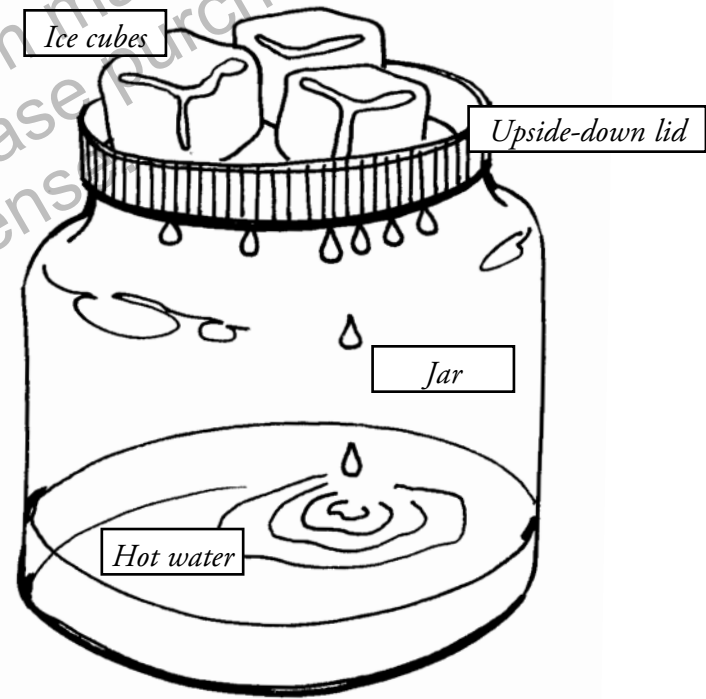
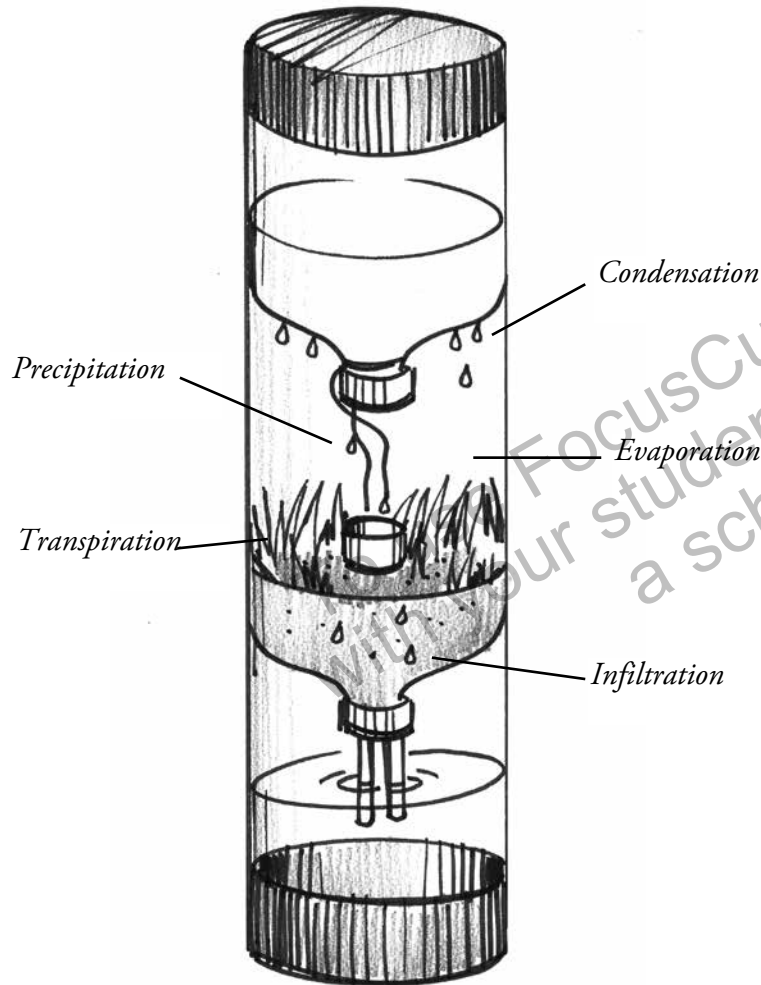
It's not until the moisture gets to the underside of leaves that it evaporates into the atmosphere.



*Ms. Understanding*



**Water Cycle Models** Make your own three-dimensional water cycle model. You can make a working model out of plastic bottles as seen in the first diagram below, or a simpler version using a glass jar with a lid as seen in the second diagram. Can you think of a different way to show the water cycle? Use your imagination!



# Chapter 1 How Does Climate Affect Earth?

## FOCUS

The underlined sentence states an important idea about how climate affects nearly everything about a place. Read this section to find out how climate shapes our world.

You've learned the difference between weather and climate. While the weather in a place can change from day to day, climate remains, for the most part, regular from one year to the next. When people talk about climate, they talk about the general patterns of weather, extreme weather events, and the seasons.

Have you ever wondered why we have deserts, rainforests, and grasslands? Or why cacti live in deserts and sloths live in rainforests? The answer to these questions is climate. A region's climate helps determine what the land is like and the kinds of plants and animals that live there. In fact, the world's biomes are controlled by climate. A biome is the community of plants and animals that have adapted to the climate in a geographic region. World land biomes include forest biomes, grassland biomes, and desert biomes. There are also water biomes.

## Forest Biomes

About a third of the land on Earth is forest. A forest is a biome where the main plants are trees or other woody plants. There are several different kinds of forests, each with a different kind of climate.

### Tropical Forest

Tropical forests have a fairly stable temperature throughout the year. There is little difference between the average temperatures of the warmest months and the coldest months. This kind of forest has no real winter, and it receives more than 80 inches (200 cm) of rain each year. There is a huge variety of plants in tropical forests, ranging from tall trees with large leaves to vines, ferns, orchids, and mosses.

Scientists divide tropical forests into smaller groups depending on when and how the rain falls during the year. For example, an evergreen rainforest has no dry season, while a seasonal rainforest has a short dry season.



*lush tropical rainforest*

## ACTIVE READER

**1 Analyze** The word “biome” is made up of bio- meaning “life” and -ome meaning “wholeness.” Why is this a good name for what a biome is?

---

---

**2 List** List three things that characterize a tropical forest.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

## Good to Know

Tropical rainforests are located near the equator. They are shrinking, though. Over one-half of tropical rainforests have been destroyed by logging, farming, development, and other human activities. Individuals and organizations are working to preserve the rainforests and their countless plant and animal species.

## Temperate Forest

**Temperate** forests have four distinct seasons, including a well-defined winter that can get quite cold. The climate is generally moderate, though. Precipitation ranges from 30 to 59 inches (75 to 150 cm) per year, while temperatures can range from -22° to 86° F (-1° to 30° C).

In temperate forests, trees such as maple, oak, and willow lose their leaves in winter while evergreen trees such as pine remain green. Many plant and animal species live in temperate forests, and many foods, such as maple sugar, mushrooms, walnuts, and apples, come from these lands.

Like tropical forests, temperate forests can be divided into smaller groups by the amount and timing of rainfall.

## Boreal Forest

The climate in boreal forests, or taiga, is very cold. Boreal forests have long, cold, dry winters and short, moist summers. These forests are found in northern areas where temperatures get very low and snow is the main type of precipitation. Approximately 16 to 39 inches (40 to 100 cm) of snow falls each year. The trees that grow in these forests, such as pine, fir, and spruce, have needle-like leaves that help them survive in cold temperatures.

### FOCUS QUESTIONS

1. How does climate shape a place?

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2. Name one way in which tropical, temperate, and boreal forests are different from each other. Explain the difference.

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### ACTIVE READER

**1 Recall** How are temperate forests like tropical forests?

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**2 Hypothesize** Do you think that boreal forests have a long or a short growing season? Explain your answer.

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Boreal forests are the largest land biome. Use the Internet to find a map showing where in the world boreal forests are.



**FOCUS**

The next part of this chapter tells about grassland biomes. Read to find out about two types of grassland biomes and what makes them different from each other.

**Grassland Biomes**

The grassland biome is dominated by grasses instead of trees or large shrubs. There are two main types of grasslands: **savannas** and temperate grasslands.

**Savanna**

A savanna is a grassland that is dotted by occasional trees. Savannas cover huge areas of Africa, Australia, South America, and India. The climate in these places is crucial in creating savannas. The temperature is warm or hot, and the rainfall each year is from about 20 to 50 inches (51 to 127 cm). What distinguishes a savanna is its pattern of rainfall. Rain falls during six or eight months of the year, after which there is a long drought.

What happens during this drought is important, too. During this dry season, fires often occur, burning back the dry stems and leaves of grass, but leaving the deep roots unharmed. When the rainy season returns, the grasses grow quickly, providing food for many kinds of animals.



*Savannas cover huge areas of Africa, Australia, South America, and India.*



*Elephants live on the African savanna.*

**ACTIVE READER**

**1 Recall** *What makes a grassland biome different from a forest biome?*

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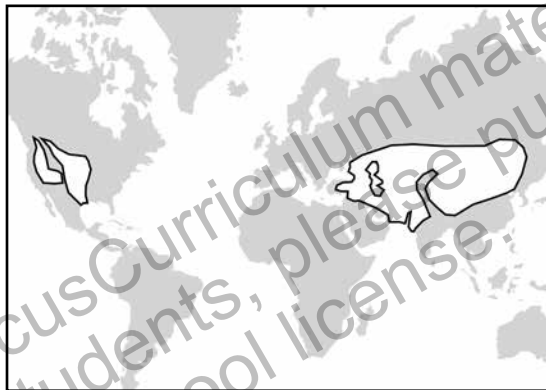
**Good to Know**

Did you know that elephants can create savannas? It happens when there are a large number of elephants in a woodland. They eat the leaves and twigs off trees and break off their branches. Then they smash the trunks and strip off the bark. Soon a woodland is a savanna!

## Temperate Grassland

Like savannas, temperate grasslands have a rainy season followed by a drought. The temperature in these grasslands varies much more than in savannas, though. Summer temperatures can reach over 38° C (100° F), while the temperature in winter can drop to -40° F (-4.5° C). There is less precipitation in temperate grasslands—20 to 30 inches (51 to 89 cm). The North American plains and prairies are examples of temperate grasslands. While the plants that grow there are mostly grasses, some trees such as cottonwoods and willows do grow in river valleys.

Like savannas, temperate grasslands have fires. Unlike fires in the savannas, their effects are not as strong. Temperate grasslands have deeper, darker, richer soils, and are good for growing. For this reason, many temperate grasslands have been converted to farming and grazing lands.



*Temperate grasslands are found in North America and Asia*

### FOCUS QUESTIONS

1. How are savannas and temperate grasslands alike?

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2. How are savannas and temperate grasslands different from each other?

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### ACTIVE READER

**1 Connect** *You have learned about temperate forests and temperate grasslands. What do you think temperate means? Check your answer with a dictionary definition.*

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**2 Research** *Temperate grasslands can be divided into smaller groups. Research and list the names of two types of temperate grasslands.*

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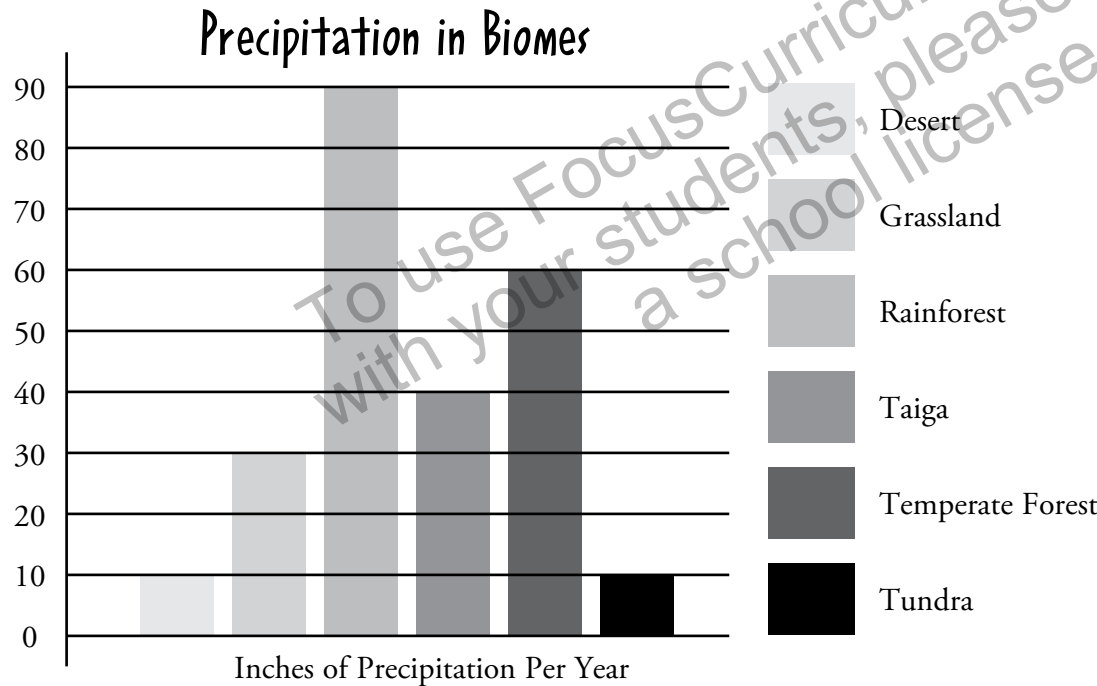


This part of the chapter tells about two biomes that have little precipitation. As you read, find out how climate has shaped these biomes.

### Desert Biomes

Death Valley. Great Sandy. The Sahara. These words probably make you think about hot sands and vast emptiness. You think about parched throats and a lack of water. You think about the desert.

About one fifth of Earth’s surface is desert. Deserts are usually very dry—most of them get less than 25 cm (10 inches) of precipitation a year. This chart compares the precipitation of deserts with other biomes.



### ACTIVE READER

**1 Identify** Underline the sentence that tells how much precipitation most deserts get each year.

**2 Analyze** Use the *Precipitation in Biomes* chart to answer these questions:

a. Which biome gets the most precipitation?

b. Which biomes get the least precipitation?

**3 Extend** What effects do you think differing amounts of precipitation have in a biome?

Although we usually think of deserts as being hot and **arid**, or dry, some deserts get quite cold. There are four main kinds of desert biomes.

## Hot and Dry Desert

The Chihuahan, Sonoran, and Mojave deserts are three North American deserts that are very hot and dry. The amount of moisture in the air is a major cause of the extreme temperatures in this kind of desert. Because there is so little moisture in the air to block the sun's rays, hot and dry deserts receive more heat during the day than humid areas. They also lose almost twice as much heat at night. Temperatures can get as high as 120° F (49° C) and can drop to 0° F (-18° C). Depending on the desert, it can rain from 0.5 to 11 inches (1.5 to 28 cm) a year. Because of the extremely hot, dry conditions, rain sometimes evaporates before it reaches the ground.

It's difficult to imagine how plants and animals can survive in this hostile environment, but they do. Plants that live in these types of deserts are usually short, with small thick leaves or spines that help them conserve water. Many desert animals stay inactive during the day and come out at dawn, dusk, and night to forage for food.

## Semi-arid Desert

Semi-arid deserts have long, dry summers where daytime temperatures don't go above 100° F (38° C), and the evenings cool off to about 50° F (10° C). Rainfall averages 0.8 to 1.58 inches (2 to 4 cm) each year. However, the cool nights help water condense as dew. Some semi-arid deserts receive more dew than rain!

Spines, thorns, and hairs help the plants that grow in semi-arid deserts conserve water. Some plants have shiny, silvery leaves that help them reflect the sun's energy. Animals that live in the semi-arid desert have different ways of adapting, including living in underground burrows. Some even follow the moving shadows of plants to stay cool!



*Plants that live in a hot, dry desert are usually short with thick leaves or spines.*



*Semi-arid desert have long, dry summers*

**Dear Ms. Understanding,**

I'm worried about something I heard about called desertification. Why do the deserts keep growing and growing? Will they take over the world?



*Dreads Death Valley*

**Dear Dreads,**

You're right to worry about desertification, and a lot of desertification does take place in arid and semi-arid lands. But it is a common misunderstanding that desertification spreads from a desert core. Desertification happens when dry lands expand because of poor agricultural practices such as over-cultivation, overgrazing, and cutting down forests for fuels. It can even happen far from deserts!



*Ms. Understanding*

## Coastal Desert

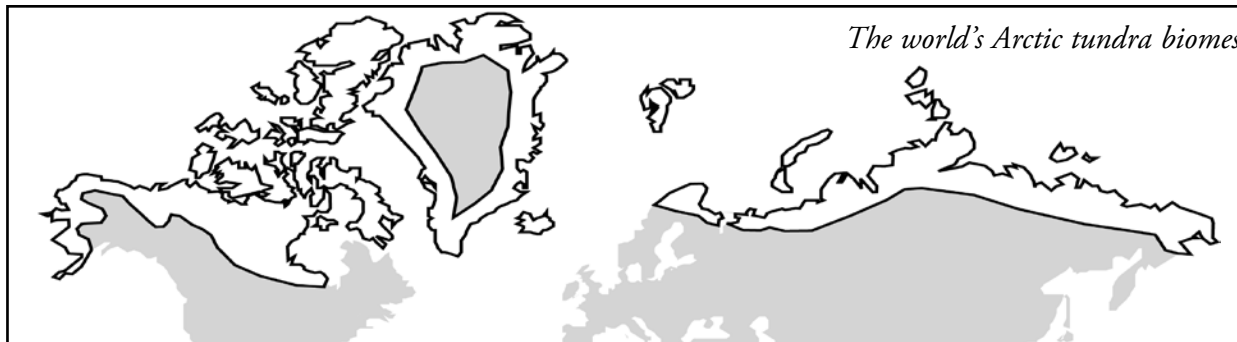
Coastal deserts have long, warm summers with average temperatures of 55° to 75° F (13° to 24° C). Winter temperatures can drop to 5° C (41° F) or lower. The average rainfall in this kind of desert is from 3 to 5 inches (8 to 13 cm). The plants in coastal deserts have shallow roots in order to receive what little rain falls. Their stems and leaves are thick and can store water for use during dry times.

## Cold Desert

This kind of desert might not seem like a desert to many people. The winters are cold, with both rain and snow, and an average temperature of 28° to 39° F (-2° to 4° C). The average summer temperature is between 70° and 79° F (21° and 26° C). Cold deserts can receive as little precipitation as 3.5 inches (9 cm) or as much as 18 inches (46 cm). Most plants in cold deserts have spiny leaves, which they lose in the winter. These plants are scattered over the desert.

## Tundra Biomes

The coldest biome in the world is the tundra. The Arctic tundra circles the North Pole. Snow and ice cover the ground, and even the sea freezes sometimes. The Arctic tundra has a layer of permanently frozen soil called permafrost. Winters are very long, with an average temperature of -30° F (-1° C). Summers are short with average temperatures of 37° to 54° F (3° to 12°C). This biome only gets 6 to 10 inches (15 to 25 cm) of precipitation a year, which includes melting snow. Plants in the Arctic tundra have shallow roots, and they grow tightly grouped to survive the extreme cold. They include low shrubs, mosses, grasses, flowers, and lichen.



## ACTIVE READER

**1 Recall** Write coastal beside the details that describe coastal deserts. Write cold beside the details that describe cold deserts. Write tundra beside the details that describe tundras.

permafrost \_\_\_\_\_

46 cm precipitation \_\_\_\_\_

coldest biome \_\_\_\_\_

long, warm summers \_\_\_\_\_

## Good to Know

- Tundra means “treeless plain” (it comes from the Finnish word tunturi).
- One tree grows in the tundra: the dwarf willow. It is 10 cm (4 inches) tall!
- In the tundra during the summer, the sun shines all the time, even at midnight.
- The tundra has “white outs” that last for days, when winds blow the snow so much that you can’t see!

The second type of tundra is the Alpine tundra. This biome is found on mountains around the world at such high altitude that trees can't grow. The climate in the Alpine tundra is extremely harsh. In some places snowfields are permanent. The frost-free season is only about one and a half months; even so, the Alpine tundra has a longer growing season than the Arctic tundra. The plants that grow in the Alpine tundra are similar to those that grow in the Arctic tundra.

**FOCUS** QUESTIONS

1. What role does climate play in the development of the desert and tundra biomes?

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2. How are desert and tundra biomes alike?

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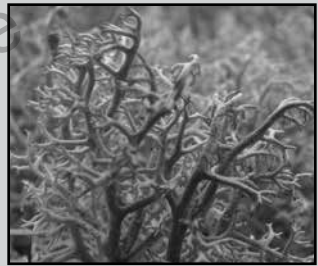
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**CONCLUSION**

In this book you have learned about the many ways in which weather and climate affect our planet—from the weather you experience every day to the plants that grow in a region. You've learned what causes the weather and how temperature and precipitation determine what a biome is like. On the lines at the right, write any questions you still have about Earth's Climatic Zones. Use Internet resources to find the answers.

**Good to Know**

Lichens flourish in harsh environments such as the tundra. Lichens do not need much water and can even grow on rocks.



Reindeer moss, pictured above, was so named because it provides food for reindeer in the tundra. Reindeer moss is actually a lichen.

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**Investigate Your Biome** Do research to complete the chart below with information about where you live. Then use the information in Chapter 2 to identify your biome.

Climate
Seasonal Variation: _____
Average Temperatures During Each Season: _____
Precipitation During Each Season: _____
Type of Soil
Plant Life
Animal Life
Biome Name

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Stop and Think

This page will help summarize what you have read so far. Use the tip to help you answer the questions.

1. Which definition correctly describes a biome?

- (1) the animals in a geographic region
- (2) weather that affects both plants and animals
- (3) plants that live in a temperate environment
- (4) living things that have adapted to a region's climate

2. What are the two main factors that help to determine what lives in a biome?

- (1) wind and humidity
- (2) the equator and the poles
- (3) evaporation and transportation
- (4) precipitation and temperature

Base your answers to questions 3 and 4 on the information below and on your knowledge of science.

Savannas and temperate grasslands are both examples of grassland biomes.

3. Explain how these two biomes are alike and different.

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4. Describe the climate in each type of biome.

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**Tip:**  
To help you answer question 1, look back at the second paragraph of Chapter 1 and find the definition of biome. Then find the answer that matches.

Dear Ms. Understanding,

Why does it seem hotter in humid places than it does in places that are just as hot, but drier?



*Sweating in Spring Valley*

Dear Sweating,

The human body regulates its temperature in part by sweating. When it's humid, sweat does not evaporate as well because the air itself is full of moisture. As a result, you feel hotter.



*Ms. Understanding*



# Glossary

**aquifers** – underground layers of rock, soil, gravel, or sand that hold enough fresh water to supply wells and springs

**arid** – lacking sufficient water or rainfall

**atmosphere** – the mass of air that surrounds Earth

**biomes** – geographical areas characterized by their climate and living organisms

**climate** – the average condition of weather over a period of years

**condensation** – the process by which water vapor turns into liquid water

**desert** – a biome with little precipitation and usually sparse vegetation

**dew point** – the temperature at which vapor begins to condense

**evaporation** – the process by which water changes from a liquid into a gas

**humidity** – a measure of water in the air

**hydrosphere** – all the water of Earth, including the water vapor in the atmosphere

**infiltration** – a process in which water on the ground filters down through rock and soil

**precipitation** – rain, sleet, snow, hail, and other forms of water that fall from the sky

**relative humidity** – the percentage of water vapor in the air compared with the amount of water vapor the air can hold when it is saturated

**runoff** – precipitation that is not absorbed and flows across the land

**saturated** – full of moisture; unable to hold any more water vapor

**savannas** – grasslands sparsely dotted with trees

**temperate** – having a climate that lacks extremes

**transpiration** – the process by which plants release water into the atmosphere

**troposphere** – the lowest part of the atmosphere, in which most weather occurs

water vapor – water in its gas form

**weather** – the state of the atmosphere at a certain place and time

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**FOCUS  
ON  
SCIENCE**

# Earth's Climatic Zones

Assessments

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# Check Understanding



In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. An airline pilot climbs to a higher altitude to get above the building rain clouds.

The pilot is most likely traveling between which two atmospheric layers?

- (1) mesosphere and stratosphere
- (2) troposphere and stratosphere
- (3) thermosphere and mesosphere
- (4) stratosphere and thermosphere

2. Which biome is characterized by a very cold climate with about 40–100 cm of snow each year?

- (1) tundra
- (2) cold desert
- (3) boreal forest
- (4) temperate grassland

3. Which contains all of Earth's water?

- (1) troposphere
- (2) hydrosphere
- (3) lithosphere
- (4) atmosphere

4. A student walking to school splashes through puddles left on the sidewalk by last night's precipitation. It's still cold, but the sun is out and the weather forecast says it will be a warm day.

Which part of the water cycle describes what will happen to the puddle next?

- (1) runoff
- (2) infiltration
- (3) evaporation
- (4) transpiration

## Answer Document

- |    |   |   |   |   |    |   |   |   |   |
|----|---|---|---|---|----|---|---|---|---|
| 1. | ① | ② | ③ | ④ | 3. | ① | ② | ③ | ④ |
| 2. | ① | ② | ③ | ④ | 4. | ① | ② | ③ | ④ |

# Check Understanding



Base your answers to questions 5 and 6 on the information below and on your knowledge of science.

Students in one school have asked others from around the state to observe the weather every day and record data for a science project. The students plan to compare the data and look for statewide weather patterns. The chart below shows the data one student collected on a particular day. However, some important information is missing. Answer parts A and B about the chart.

Temperature	Precipitation	Wind Speed
33°F	sleet	10 mph
30°F		8 mph
27°F	light snow	

5. Identify one example of information that should have been included in the chart.
- \_\_\_\_\_
- \_\_\_\_\_
6. Explain how the incomplete data will make it difficult for students to make comparisons and look for weather patterns.
- \_\_\_\_\_
- \_\_\_\_\_

Base your answers to questions 7 and 8 on the photograph below and on your knowledge of science.



7. What biome is shown in the photograph?
- \_\_\_\_\_
- \_\_\_\_\_
8. What is the climate of the biome like? Include information about temperatures and precipitation.
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**FOCUS  
ON  
SCIENCE**

# Earth's Climatic Zones

Answer Key

# Answer Key

## Page 8: Starting Points

### Build Background

**Use Your Knowledge:** Answers will vary.  
Think Like a Scientist: Keep a Weather Journal: Answers will vary.

## Page 11: Starting Points

### Key Vocabulary

**Rate Your Knowledge:** Answers will vary.  
Use Roots to Unlock Meaning:  
1. troposphere and atmosphere;  
The troposphere is a layer of Earth's atmosphere, which surrounds Earth, a globe. 2. thermometer

## Page 12: Starting Points

### Key Concepts

**Active Reader:** 1. Answers will vary.

## Page 13: Chapter 1

**Active Reader:** 1. No, because weather is dependent on the place and time.  
2. troposphere

## Page 14: Chapter 1

**Active Reader:** 1. Mesosphere means “middle globe.” It makes sense because it is one of the middle layers of the atmosphere.  
**Focus Questions:** 1. Weather is the state of the atmosphere at a certain time and place. Most weather takes place in the troposphere, which is the lowest part of the atmosphere.

2. They avoid bad weather by going past the troposphere, where most weather occurs.

## Page 15: Chapter 1

**Hands On Science:** Investigate the Atmosphere: jet – stratosphere; cloud – troposphere; space shuttle – thermosphere; meteorite – mesosphere; International Space Station – thermosphere

## Page 16: Chapter 1

**Active Reader:** 1. Because all the water that exists today also existed when dinosaurs roamed Earth.

## Page 17: Chapter 1

**Active Reader:** 1. Most of the water is in storage. 2. Underline: During evaporation, water changes from liquid into gas. 3. Questions will vary.

## Page 18: Chapter 1

**Active Reader:** 1. Underline: Condensation is the process by which water vapor changes into liquid water. 2. Sample answer: Water that collects on the mirror after a hot shower

## Page 19: Chapter 1

**Active Reader:** 1. Precipitation is all water that comes from clouds; Runoff is precipitation that flows along the ground.

## Page 20: Chapter 1

**Active Reader:** 1. Circle: Even though you can't see it, there are vast amounts of water underground. Water that is stored beneath Earth's surface is called groundwater, and it is an important part of the water cycle. It feeds streams, rivers, and wetland habitats. People use groundwater for drinking and irrigation. To reach it, they dig wells.  
2. Infiltration occurs when water flows down between rocks and soil into Earth.  
**Focus Questions:** 1. The water cycle describes how the water on Earth travels from the atmosphere to the ground again and again. 2. The sun heats the air, which rises and cools. The cooler air becomes saturated with water vapor. When the air temperature drops below dew point, the water vapor changes into water droplets.

## Page 21: Chapter 1

**Stop and Think:** 1. (3); 2. (4); 3. (3)



# Answer Key

## Page 23: Chapter 2

**Active Reader:** 1. A biome describes all the life that lives in a certain geographic region. 2. stable temperature, more than 200 cm of rain, variety of plants

## Page 24: Chapter 2

**Active Reader:** 1. They can be divided into smaller groups by amount and timing of rainfall. 2. Answers will vary.

**Focus Questions:** 1. Climate influences what the land is like and the kinds of plants and animals that live there. 2. Tropical forests have a similar temperature year-round while temperate forests experience a wide range of temperatures and boreal forests have one long winter and a very short summer.

## Page 25: Chapter 2

**Active Reader:** 1. A grassland biome has mainly grasses instead of trees, like a forest biome.

## Page 26: Chapter 2

**Active Reader:** 1. Temperate means, “neither very hot or very cold.” 2. tall-grass and short-grass

**Focus Questions:** 1. Savannas and temperate grasslands have a rainy season and then a drought. 2. The temperature in temperate grasslands varies more than it does in savannas. Summers can be very hot while winters can be very cold.

## Page 27: Chapter 2

**Active Reader:** 1. Underline: Deserts are usually very dry—most of them get less than 25 cm (10 inches) of precipitation a year. 2. a. Rainforest; b. tundra and desert; 3. Answers will vary.

## Page 29: Chapter 2

**Active Reader:** 1. tundra, cold, tundra, coastal

## Page 30: Chapter 2

**Focus Questions:** 1. The lack of precipitation causes most deserts to be very dry. The low temperatures cause the tundra to have very short summers and long, cold winters. The climate determines what plants and animals can survive in these biomes. 2. Both biomes are characterized by harsh conditions where it is difficult to live.

## Page 31: Chapter 2

**Think Like a Scientist: Investigate Your Biome:** Answers will vary depending on where the student lives.

## Page 32: Chapter 2

**Stop and Think:** 1. (4); 2. (4); 3. Savannas and temperate grasslands are alike because both have a rainy season and then a drought. They are different because temperate grasslands have a greater variation in temperature.; 4. Savannas are grasslands with a few trees. They experience warm or hot temperatures, have a rainy season, and a drought. Temperate grasslands have both hot

and cold temperatures, a rainy season and a drought. They have rich soil that is good for farming.

## Page 37: Check Understanding

1. (2); 2. (3); 3. (2); 4. (3)

## Page 38: Check Understanding

5. The precipitation should have been measured when the temperature was 30° F and the wind speed was 8 mph.; 6. Accurate data is needed in order to identify patterns. The students cannot draw accurate comparisons between temperature, precipitation and wind speed as it is.; 7. Tropical forest; 8. Tropical forests have a similar temperature throughout the year. They receive at least 200 cm of rain per year. The plant life is diverse.

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