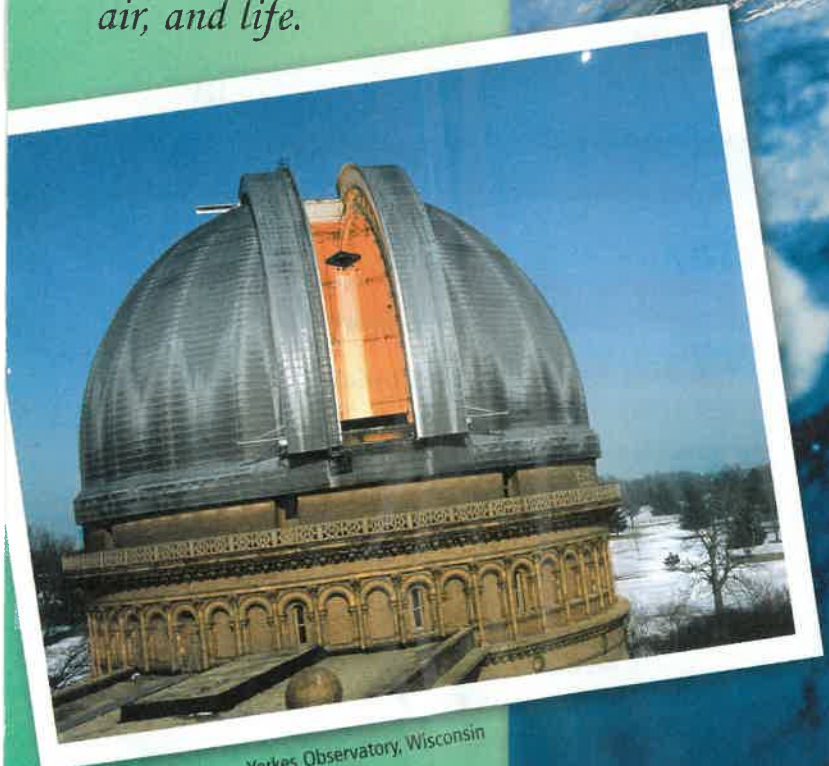
CHAPTER 2

# Earth in Space

*Earth is our home in the universe. In this chapter, you will learn about Earth's position in the solar system and relation to other objects in space. You will also learn about the Earth system—the interactions of Earth's land, water, air, and life.*



Yerkes Observatory, Wisconsin

Section 1

# The Solar System

**HOLT**
**Geography's Impact Video Series**
Watch the video to understand the impact of the sun on the Earth.

**READ TO DISCOVER**

1. What is Earth's position in the solar system?
2. How do rotation and revolution affect Earth?

**DEFINE**

solar system
planets
moons
satellite
solar energy
rotation
revolution

## Reading Strategy

**READING ORGANIZER** Draw a line down the center of a sheet of paper to create two columns. Title one column What I Know. Title the other column What I Learned. Before you read, write down what you know about the solar system in the first column. As you read the section, write down the information you learn in the other column.

## Space and the Universe

If you look at the sky on a clear night, you can see thousands of stars. With a telescope you can see millions more. Beyond the telescope's view are trillions more. All these stars are part of the universe. The universe is made up of all existing things, including space and Earth. Most astronomers believe that the universe is 10 to 20 billion years old. Since its birth, the universe has been expanding continuously. It is unimaginable in size.

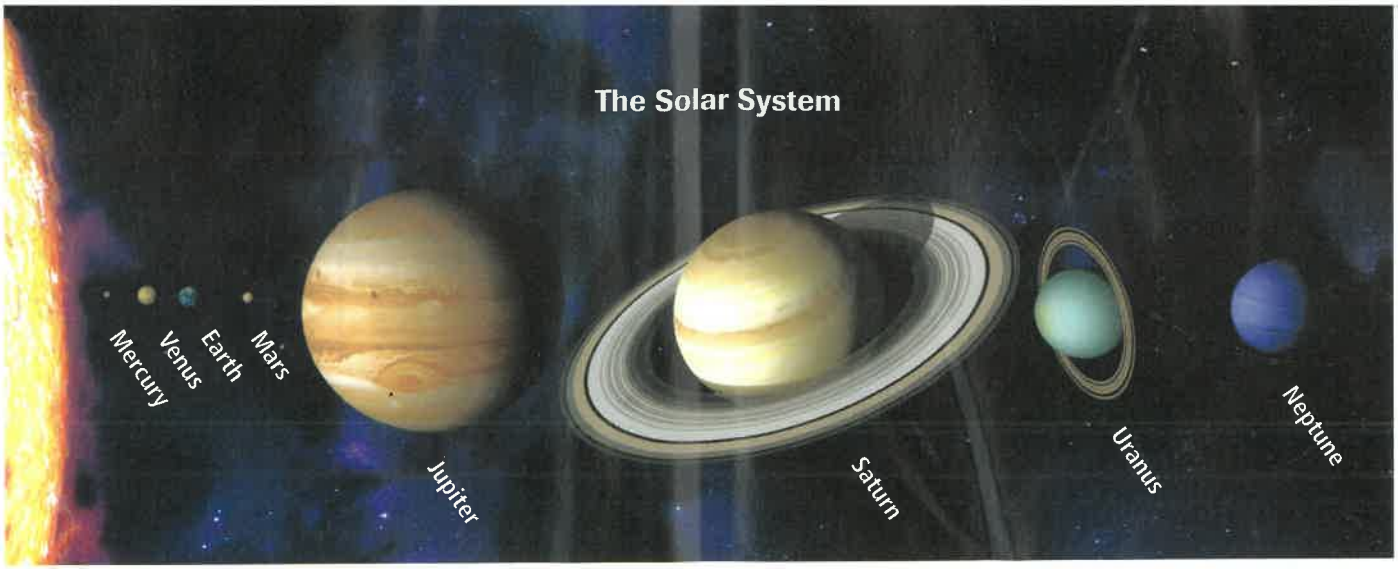
Space is filled with large objects called stars. Most stars are grouped together in huge clusters called galaxies. Many objects that look like individual stars to the naked eye are really billions of stars in a faraway galaxy. The Milky Way is the galaxy in which we live. The part of this galaxy that we can see from Earth looks like a bright milky streak across the night sky. The Sun is a medium-size star near the edge of the Milky Way.

When you look up at the night sky, do you ever wonder if there are places with life other than Earth? Scientists wonder about this and continue to search for clues. The vast universe holds unlimited possibilities for future discovery.

**READING CHECK:** *Physical Systems* What are large groups of stars such as the Milky Way called?

*This image of the Eagle Nebula shows an area where new stars are formed. The pillars of gas and dust contain material that condenses and ignites, forming stars.*

**The Planets** The Sun and the group of bodies that revolve around it are called the **solar system**. The Sun's great size attracts the other objects through gravity. Besides the Sun, the solar system includes **planets**, dwarf planets, and small solar system bodies, such as asteroids and comets. Unlike stars, planets do not generate their own light. They are visible to us because they reflect sunlight.




*This diagram shows the eight planets and their relative sizes. However, the relative distance of each planet from the Sun is not accurate.*

In 2006, after heated debate, the International Astronomical Union changed the definition of a planet. The new definition decreased the number of planets in the solar system to eight—eliminating Pluto. Pluto and other objects such as UB313, an icy object larger than Pluto, are now classified as dwarf planets. UB313, nicknamed Xena, is the largest dwarf planet.

Earth and the other planets look like they are perfectly round. However, this is not exactly correct. Earth's polar areas are slightly flattened. Around the equator, Earth is slightly bulged. This slight variation of a perfect sphere is called an oblate spheroid. *Oblate* means "flattened."

**Moons** are smaller objects that orbit a planet. A body that orbits a larger body can also be called a **satellite**. Moons are natural satellites. Earth has one moon. However, hundreds of human-made satellites also orbit Earth. Mercury and Venus are the only planets in the solar system with no moons. Saturn has at least 18.

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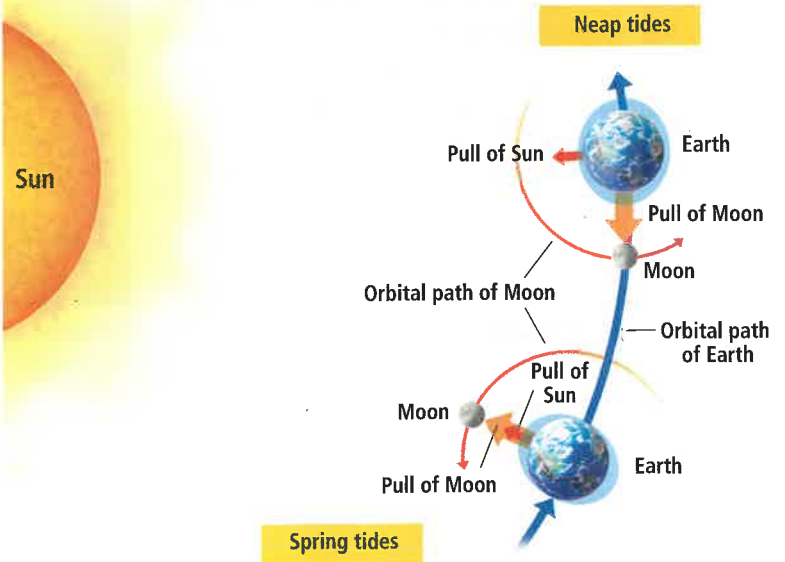
**FOR:** Web sites about Earth in space

**READING CHECK:** ***Physical Systems*** What are the main bodies that make up the solar system?

## Effects of the Moon and Sun on Tides




**INTERPRETING THE DIAGRAM** *Tides are higher than normal when the gravitational pull of the Moon and Sun combine. These tides, called spring tides, occur twice a month during the full moon and new moon. High tides are lower during neap tides, when the pull of the Sun is at a right angle to the pull of the Moon. Neap tides occur during quarter moons.* ***Why might knowing the schedule of high and low tides be important to people living in coastal areas?***

**The Sun, Earth, and Moon** The Sun is an average star in age, brightness, and size. It is small compared to huge stars called supergiants. However, compared to Earth, the Sun is very large. The diameter of Earth is about 8,000 miles (12,900 km). The diameter of the Sun is about 865,000 miles (1,390,000 km)—more than 100 times greater. The Sun operates like a giant thermonuclear reactor, releasing enormous amounts of energy.

Earth is the third planet from the Sun and the fifth-largest of the eight. Earth's orbit around the Sun is not a perfect circle. It is elliptical, or oval-shaped. Earth's orbit averages about 93 million miles (150 million km) from the Sun.

The Moon is about 240,000 miles (385,000 km) from Earth and is about one fourth the size of Earth. The Moon orbits Earth every 29.5 days, or about once every month. On clear nights you can see its surface. The Moon has a simple geography, with a barren volcanic surface and many craters. These craters were made by the impact of meteors and comets. Unlike Earth, the Moon has no air, water, or life.

The Sun, Earth, and Moon exert gravitational forces on one another that influence physical processes on Earth. The most obvious of these are the rise and fall of ocean tides. Tides are the response of the fluid ocean surface to the gravitational pull of the Moon and Sun. (See the diagram of tides.)

**READING CHECK:** ***Physical Systems*** What causes ocean tides?

*Between 1968 and 1972 NASA's Apollo missions landed astronauts on the Moon six times. In this photo, astronaut Harrison Schmitt studies a boulder in the Taurus-Littrow Valley. Schmitt made detailed descriptions of craters, boulders, and debris and helped bring back some 249 pounds (113 kg) of lunar material.*

## Earth's Rotation, Revolution, and Tilt

Most of Earth's energy comes from the Sun. This type of energy is called **solar energy** and reaches Earth as light and heat. All life on Earth depends on solar energy. Solar energy affects weather, plants, animals, and human activities. It influences the clothes we wear, the homes we live in, the foods we grow and eat, and even which sports we play. Three different relationships between Earth and the Sun control how much solar energy is received at different locations. Do you know what these are?

**Rotation** Imagine that Earth has a rod running through it from the North Pole to the South Pole. This rod represents Earth's axis, and the planet spins around on it. One complete spin of Earth on its axis is one **rotation**, which takes 24 hours. Earth rotates in a west-to-east direction. We see the effects of Earth's rotation as the Sun "rising" in the east and "setting" in the west. To us, it appears that the Sun is moving across the sky. Actually, it is only Earth rotating on its axis.

Solar energy strikes only the half of Earth facing the Sun. If Earth did not rotate on its axis—creating day and night—only the half facing the Sun would receive solar energy. That side of Earth would be very hot. The half of the planet facing away from the Sun would always be dark and cold. Earth's rotation allows the entire planet's surface to receive the warming effects of daylight and the cooling effects of darkness.


Unique in the solar system, Earth is the only planet with liquid water at the surface, active mountain-building processes, and life.

**Revolution** In addition to rotating on its axis, Earth revolves around the Sun. It makes one elliptical orbit, or **revolution**, every 365 1/4 days—one Earth

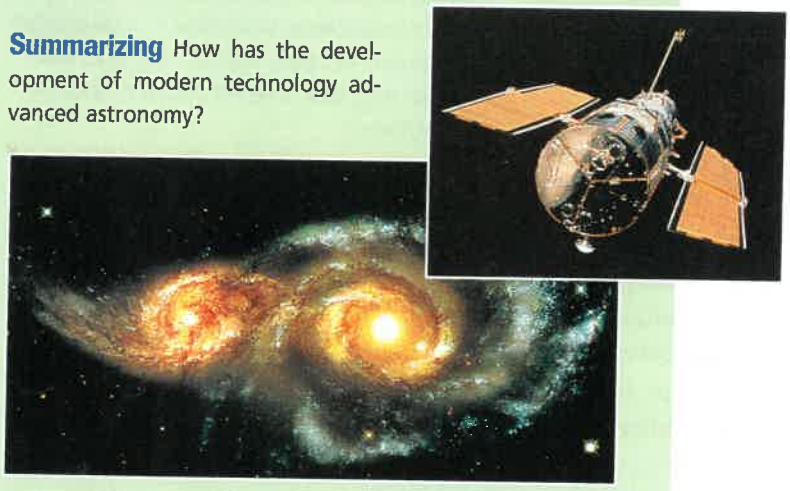
Connecting to TECHNOLOGY

## Astronomy

Astronomers study objects and matter beyond Earth. For most of history, people could see space only with the naked eye. However, with the help of modern technology, astronomers can now see far into space.

In the early 1600s the famous scientist Galileo used telescopes to study space. Telescopes magnify objects in space, making faint stars and galaxies visible. Telescopes have become central to astronomy. With the development of space-age technology, astronomy made even greater advances. For example, scientists sent out probes to collect new information about planets, moons, and other objects. The Hubble Space Telescope (shown below), built between 1978 and 1990, led to many exciting discoveries. The Hubble is the first powerful telescope ever placed in orbit around Earth, which gives it a much clearer view of space. Astronomers have used the Hubble to study black holes, galaxies, stars, and other distant objects.

**Summarizing** How has the development of modern technology advanced astronomy?



*Hubble Space Telescope image of interacting spiral galaxies NGC 2207 and IC 2163*

year. Each time you celebrate your birthday we have just completed another orbit around the Sun. For convenience, our calendars have 365 days in a year. To account for the one-fourth day gained each year, an extra day—February 29—is added to the calendar every four years. This year, one day longer than the previous three, is called a leap year.

**Tilt** If Earth's axis always pointed straight up and down in relation to the Sun, daylight hours would be the same at every location on Earth. Each day would consist of 12 hours of daylight and 12 hours of darkness. This would be true throughout the year. However, this is not the case because Earth's axis is tilted in relation to the Sun.

As Earth revolves around the Sun, its axis points toward the same spot in the sky. The North Pole points to a star known as the North Star. The position of the axis is fixed in respect to the North Star. Yet it is not fixed in relation to our Sun. Earth's orbit lies on a plane that runs from the center of the Sun to the center of the planet. Earth's axis is tilted 23 1/2 degrees from the perpendicular, or 90 degrees, to the plane of its orbit. Thus, as Earth revolves around the Sun, the North Pole points at times toward the Sun and at times away from the Sun. (See the diagram in Section 2.) The tilt of Earth on its axis affects the amount of solar energy that different places receive during the year.

**READING CHECK:** *Physical Systems* How do rotation, revolution, and tilt affect the amount of solar energy received at different locations on Earth?

## Section 1 Review

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### Define

solar system
planets
moons
satellite
solar energy
rotation
revolution

### Reading for the Main Idea

1. *Physical Systems* How are inner planets and outer planets different?
2. *Physical Systems* What is the geography of the Moon like?
3. *Physical Systems* What is the difference between rotation and revolution?

### Critical Thinking

4. **Drawing Inferences and Conclusions** How do you think technologies developed to study space can affect people's lives on Earth?

### Organizing What You Know

5. Create a chart like the one shown below. Use it to describe the Sun, Earth, and Moon.

| Sun | Earth | Moon |
|---|---|---|
| | | |

Section 2

# Earth-Sun Relationships

**READ TO DISCOVER**

1. How does the angle of the Sun's rays affect the amount of solar energy received at different locations on Earth?
2. What are solstices and equinoxes?

**IDENTIFY**

Tropic of Capricorn
Antarctic Circle
Arctic Circle
Tropic of Cancer

**DEFINE**

tropics
polar regions
solstice
equinox

## Reading Strategy

**TAKING NOTES** Taking notes while you read will help you understand and remember the information in this section. Your notes will be useful for reviewing the material. Use the headings in this section to create an outline. As you read about the earth–sun relationships, write details you learn beneath each heading. Include key terms and their definitions.

## Solar Energy and Latitude

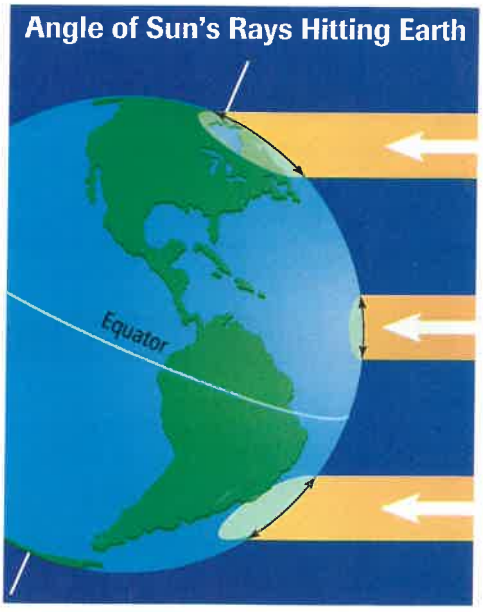
As you know, different places on Earth receive different amounts of solar energy. Areas near the equator receive a lot of solar energy all year. These places are generally warm. We call these warm low-latitude areas near the equator the **tropics**. Other places get very little solar energy. These areas are at high latitudes and are cold most of the time. Because these areas surround the North and South Poles, we call them the **polar regions**. The areas between the tropics and the polar regions are called the middle latitudes. The amount of solar energy reaching these areas changes greatly during the year. They may be warm or cool, depending on the time of year.

The amount of solar energy that a place receives relates to the angle at which the Sun's rays strike Earth. Direct vertical solar rays heat Earth's surface more than angled rays. This is because the amount of solar energy in a direct ray is concentrated on a smaller area. The same amount of energy in an angled ray is spread over a larger area.

When the North Pole points toward the Sun, direct rays strike the Northern Hemisphere. (See the diagram.) Thus, the Northern Hemisphere receives more concentrated solar energy, making temperatures warmer. The length of time between sunrise and sunset also grows longer. At this time, the Southern Hemisphere receives more angled rays and is cooler.

When the North Pole tilts away from the Sun, the most direct rays strike the Southern Hemisphere. Now, the Southern Hemisphere receives more solar energy, experiences longer days, and thus has warmer temperatures. At this time, the Northern Hemisphere receives less solar energy and has cooler temperatures.

**READING CHECK:** ***Physical Systems*** Which latitudes receive the most solar energy throughout the year?




*This diagram shows summer in the Northern Hemisphere. At this time, Earth tilts toward the Sun, and direct rays are more concentrated in the Northern Hemisphere. Meanwhile, in the polar regions and Southern Hemisphere, solar rays are spread over a larger area.*


In the 200s B.C. the Greek astronomer Aristarchus proposed that Earth rotated on its axis—creating day and night—and revolved around the Sun each year.

# The Seasons

We refer to the times of greater and lesser heat as the seasons. There are four general seasons: winter, spring, summer, and fall. Some regions, particularly the tropics, are warm year-round but have alternating wet and then dry seasons.

In each hemisphere, the Sun's energy is stronger during the summer. Daytime lasts longer. In the winter, daytime is shorter, and the Sun's energy is weaker. During spring and fall, the Sun's energy is more evenly distributed. At these times, daylight and darkness are closer to equal length. The tilt of Earth's axis causes the Northern and Southern Hemispheres to have opposite seasons at the same time of the year.

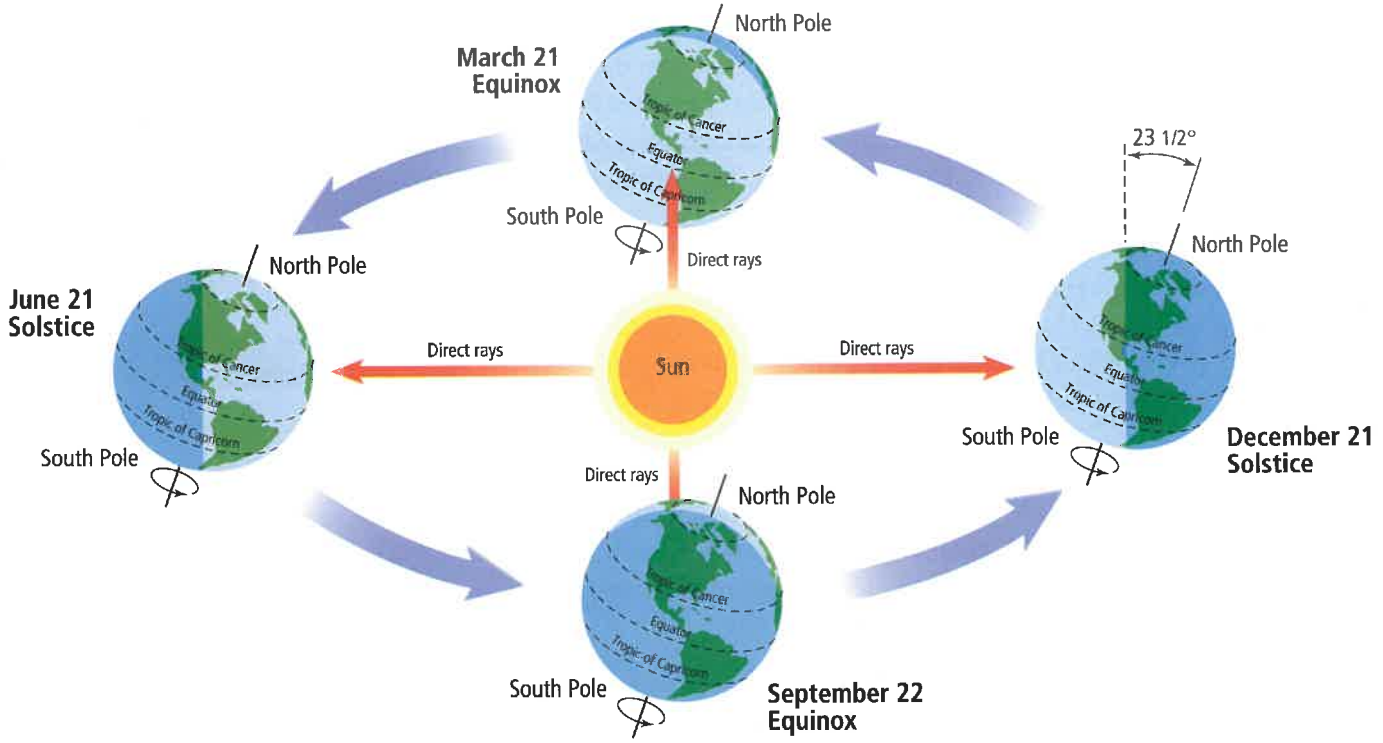
**Solstices** Twice during the year, Earth's poles tilt toward or away from the Sun more than at any other time. The time that Earth's poles point at their greatest angle toward or away from the Sun is called a **solstice**. Solstices occur each year about December 21 and June 21.

In the Northern Hemisphere, the December solstice has the fewest daylight hours of the year and is the first day of winter. The Southern Hemisphere on the same day has its greatest number of daylight hours, and it is the first day of summer. During the December solstice, the Sun's most direct rays strike Earth in the Southern Hemisphere along a parallel 23 1/2 degrees south of the equator. This parallel is called the **Tropic of Capricorn**. The South Pole is tilted toward the Sun and receives constant sunlight. All areas located south of the **Antarctic Circle** have 24 hours of daylight. The Antarctic Circle is the parallel 66 1/2 degrees south of the equator. Meanwhile, the area around the North Pole experiences constant darkness and is very cold. The parallel beyond which no

**INTERPRETING THE DIAGRAM**

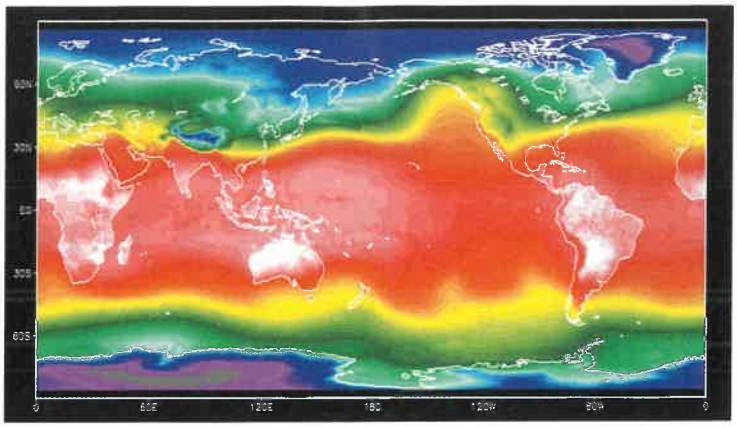
*As Earth revolves around the Sun, the tilt of the poles toward and away from the Sun causes the seasons to change.* ***On which day is the North Pole pointed directly away from the Sun?***

## The Seasons



sunlight shines on this day is known as the **Arctic Circle.** It is located 66 1/2 degrees north of the equator.

During the June solstice, the Northern Hemisphere experiences the greatest number of daylight hours of the year and the first day of summer. On this day, the North Pole tilts toward the Sun. The Sun's direct rays are at their most northerly position, striking Earth at a line 23 1/2 degrees north of the equator. This line is called the **Tropic of Cancer.** If you traveled to Australia on the June solstice, it would be the first day of winter, which has the fewest daylight hours of the year. During the June solstice, the Sun never sets north of the Arctic Circle. Daylight lasts 24 hours. During this time, the opposite occurs south of the Antarctic Circle, where darkness lasts 24 hours.



**INTERPRETING THE MAP** *This map shows Earth's average temperatures during December 19–25, 1999. Warmer temperatures are shown in red and yellow and colder temperatures are shown in purple and blue.* ***Where was the North Pole tilted in relation to the Sun when this data was collected? How did this affect the distribution of temperatures on Earth?***

**READING CHECK:** ***Physical Systems*** When is the first day of winter in the Northern Hemisphere? In the Southern Hemisphere?

**Equinoxes** An **equinox** occurs twice each year when Earth's poles are not pointed toward or away from the Sun. *Equinox* means "equal night" in Latin. At this time, the direct rays of the Sun strike the equator, and both poles are at a 90 degree angle from the Sun. Both hemispheres receive an equal amount of sunlight—12 hours each.

Equinoxes occur on about March 21 and September 22. In the Northern Hemisphere, the March equinox marks the beginning of spring. To people living in the Southern Hemisphere, however, the March equinox marks the beginning of fall. The opposite situation occurs about September 22. Days between the solstices and equinoxes gradually become warmer or cooler, and daytime becomes longer or shorter, depending on where you live. This cycle is repeated each year, creating the four seasons.

**READING CHECK:** ***Physical Systems*** When is the first day of spring in the Northern Hemisphere? In the Southern Hemisphere?

## Section 2 Review

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Keyword: SW3 HP2

### Identify
Tropic of Capricorn
Antarctic Circle
Arctic Circle
Tropic of Cancer

### Define
tropics
polar regions
solstice
equinox

### Reading for the Main Idea
1. ***Places and Regions*** Where are the tropics and polar regions found?
2. ***Places and Regions*** Where does the amount of solar energy Earth receives vary most during the year?

### Critical Thinking
3. **Analyzing** When does winter occur on Earth? Explain your answer.
4. **Drawing Inferences and Conclusions** How do you think the tilt of Earth on its axis might affect life in the polar regions?

### Organizing What You Know
5. Create a chart like the one shown below. Use it to describe the location, amount of solar energy received, and the time of year when solar energy is received for each region.

| Tropics | Middle latitudes | Polar regions |
|---|---|---|
| | | |

# Skill-Building Activity

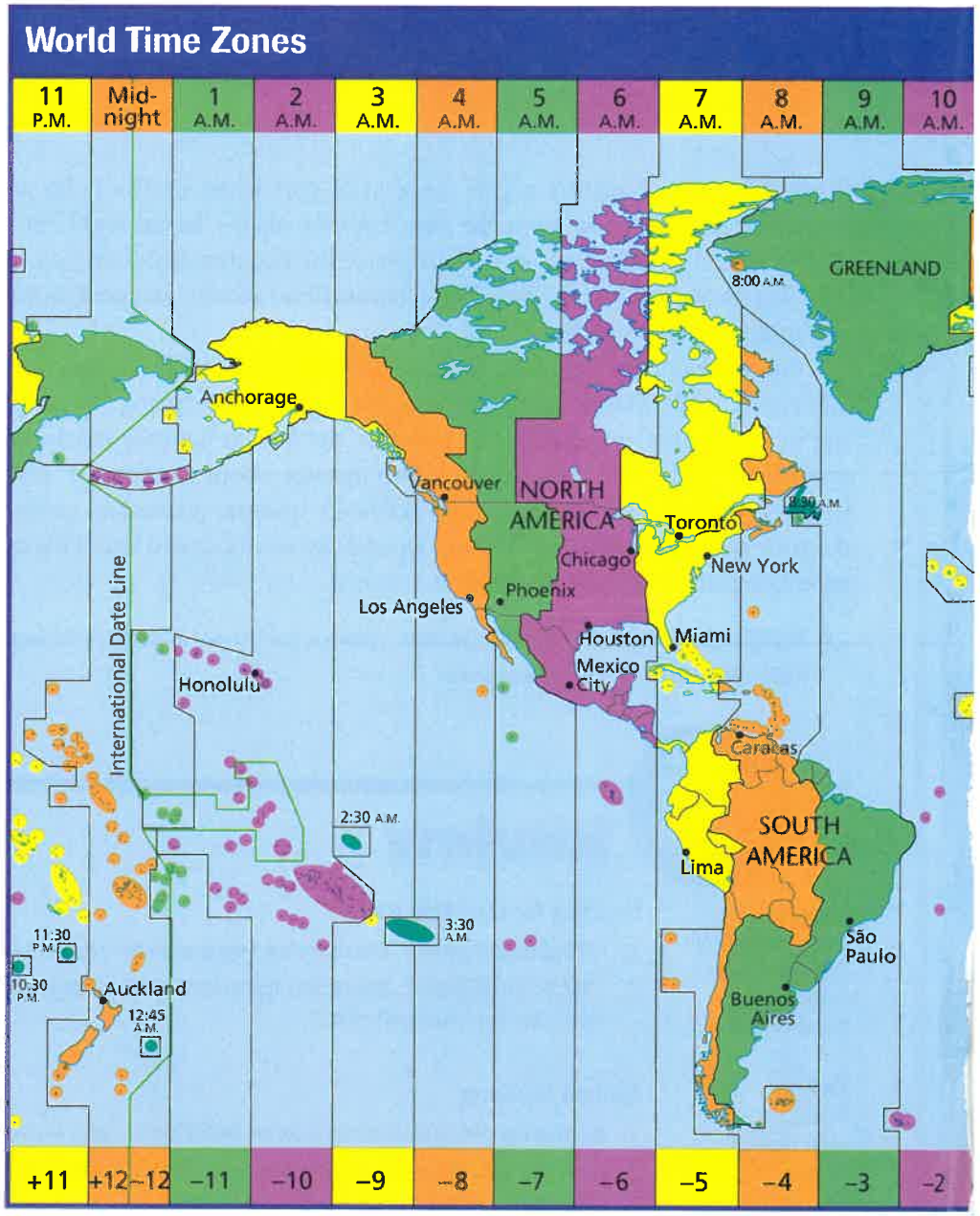
## Using a Time Zone Map

Because the Sun is not directly overhead every place on Earth at the same time, clocks are adjusted to reflect the difference in the Sun's position. Earth rotates on its axis once every 24 hours, so in one hour it makes 1/24 of a complete revolution. Since there are 360 degrees in a circle, we know that Earth turns 15 degrees of longitude each hour (360° ÷ 24 = 15°).

Earth turns in a west-to-east direction. As a result, the Sun rises first in New York, for example, and later in Los Angeles, which is farther west. If one place has the Sun directly overhead at noon, another place 15 degrees to the west will have the Sun directly overhead one hour later. The planet will have rotated 15 degrees during that hour. To account for this, we divide Earth into 24 time zones. Each time zone covers about 15 degrees of longitude. The time is an hour earlier for each 15 degrees you move westward on Earth. It is an hour later for each 15 degrees you move eastward. For example, if the Sun rises at 6:00 A.M. in New York, it is still only 3:00 A.M. in Los Angeles, three time zones to the west.

By international agreement, longitude is measured from the prime meridian, which passes through the Royal Greenwich Observatory in Greenwich (GREN-ich), England. Time is also measured from Greenwich and is called Greenwich mean time (GMT) or universal time (UT). For each time zone east of the prime meridian, clocks are set one hour ahead of GMT. For each time zone west of Greenwich, clocks are set one hour behind GMT. For example, when it is noon in London, England, it is 1:00 P.M. in Rome, Italy, one time zone to the east. At the same time, it is 7:00 A.M. in New York City, five time zones to the west.

Halfway around the planet from Greenwich is the international date line. It is a north-south line that runs through the Pacific Ocean. It generally follows the



180° line of longitude. However, sometimes it leaves this line to avoid dividing island countries. When you cross the international date line, the date and day change. If you cross the date line from west to east, you gain a day. If you travel from east to west, you lose a day.

As you can see from the World Time Zones map, time zones do not follow meridians exactly. Instead, time zone lines often follow political boundaries. For example, in Europe and Africa many time zones follow country borders. The contiguous United States has four major time zones: eastern, central, mountain, and Pacific. Alaska and Hawaii are in separate time zones to the west. Some countries make local adjustments to the time in their time zones. For example, most of the United States has daylight savings time in the summer. People in places with daylight savings time adjust their clocks to have more daylight during the evening hours.


## Practicing the Skill

1. In which time zone do you live? Check your time now. What time is it in New York?
2. How many time zones does China have?
3. If it is noon in New York, what time is it in London?

Section 3

# The Earth System

**READ TO DISCOVER**

1. What are Earth's four spheres?
2. How is Earth's environment unique in the solar system?

**DEFINE**

**atmosphere**
**lithosphere**
**hydrosphere**
**biosphere**
**environment**

## Reading Strategy

**TAKING NOTES** Taking notes while you read will help you understand and remember the information in this section. Your notes will also be useful for reviewing the material. Before you read, write the main ideas (the headings) down the left side of a sheet of paper. As you read this section, write beside the main ideas the supporting details you learn about the Earth system.

## Earth's Four Spheres

Earth is a complex planet. Its different parts interact in a vast number of ways. The scale of some Earth interactions is so small that they are hard to notice. For example, ants and termites help mix decayed plant matter and soil in some places. Other interactions, such as rainfall and flooding, affect large regions.

Geographers call all these interactions the Earth system. A system is a group of different parts that interact to form a whole. Major parts of Earth can be viewed as separate from each other. However, they interact constantly. For example, when a volcano erupts, it not only affects the mountain where it is located but also the air, water, and life around it. Some large eruptions can affect global weather patterns. People are also part of the Earth system. Our actions affect Earth in many ways. For example, people convert large areas of Earth into farmland. This affects plant and animal life, soil fertility, and water use.

*Kilauea volcano, on the island of Hawaii, is one of the largest, most active volcanoes in the world. Kilauea has been erupting steadily since 1983 and has generated numerous lava flows, which have added more than 500 acres (200 hectares) of land to the island. In 1986 Kilauea began releasing large amounts of sulfur dioxide gas into the air. This gas reacts chemically with particles in the air to produce volcanic smog, or "vog," which contaminates rainwater and causes a health hazard.*

Geographers divide the Earth system into four major parts. Each part is called a sphere because it occupies a shell around the planet. The **atmosphere** is the envelope of gases that surrounds Earth. It is the least dense and outermost sphere, extending from Earth's surface into space. Earth's gravity holds the atmosphere around the planet. About 78 percent of Earth's atmosphere is a gas called nitrogen, and about 21 percent is oxygen. The rest is made up of carbon dioxide, ozone, and other gases. These gases and water vapor sustain life on Earth. The atmosphere also protects the planet from the Sun's harmful radiation.

The **lithosphere** is the solid crust of the planet. This outer crust includes rocks and soil. It forms Earth's continents, islands, and ocean floors.

The **hydrosphere** is all of Earth's water. Water covers about 70 percent of Earth's surface. The hydrosphere includes water in liquid, solid, and gaseous forms. Liquid water is found in oceans, lakes, rivers, and underground. Clouds and fog are made up of liquid droplets. Solid water, or ice, is found on both land and sea. Large amounts of ice are locked in glaciers in the polar regions. Earth is the only planet in the solar system known to have large amounts of surface water. Water is essential to all living organisms.

The **biosphere** is the part of Earth that includes all life forms. It includes all plants and animals. The biosphere overlaps the other three spheres. It extends from deep ocean floors to high in the atmosphere.

Earth's four major spheres are all interconnected. Each one affects the other. For example, the hydrosphere supplies people with water, which we need to live. It is also a home for plants and animals. The hydrosphere affects the lithosphere when rain breaks up rocks and washes them away. It also constantly interacts with the atmosphere, causing clouds and rain.

**READING CHECK:** ***Physical Systems*** How are Earth's four spheres different from each other?

*Earth's atmosphere from space*

*Earth's lithosphere—a volcano in Hawaii*

*Earth's hydrosphere—waves off the Oregon coast*

*Earth's biosphere—a rain forest in New Zealand*

## Earth's Environment

Earth's four spheres make up the **environment**, or surroundings. The environment includes all the biological, chemical, and physical conditions that interact and affect life. Within our solar system, no other planet has an environment as complex as Earth's. Our closest neighbors, Venus and Mars, each have an atmosphere and a lithosphere. However, neither has a vast supply of liquid water. In recent years, scientists have looked far into space. They have discovered many other stars that have planets. In fact, scientists have found more than 50 planets outside our solar system. Do you think there is another planet in the universe that has the right environmental conditions for life?


*Glen Canyon Dam, located in northern Arizona on the Colorado River, was completed in 1964 and created Lake Powell, a large reservoir that provides water and electricity to western states. Some environmental groups argue that the dam has disrupted the river's natural ecosystems and that Lake Powell should be drained. For some, the controversy surrounding the construction of the dam marked the beginning of the modern environmental movement.*

Earth's environment is the key to our survival and quality of life. Therefore, we must be aware of how our activities affect the planet. One way we can learn more about Earth's environment is by studying environmental issues.

## FOCUS ON CITIZENSHIP

**Environmental Issues** Many people today are concerned about the effects humans have on the environment. In fact, many geographers study a variety of environmental issues. These geographers study how to solve environmental problems at local, state, national, and international levels. Environmental studies can help us learn how to solve difficult environmental problems. They can also help us learn more about the world around us.

People often have different points of view about environmental issues. These different points of view can influence public policies and affect how decisions are made. For example, suppose government officials want to build a new dam. Some citizens might support the idea. A new dam could create jobs, prevent flooding, and increase water supplies. However, other people might oppose the construction of a new dam. They might be concerned that it would harm the environment. Some fish species might be threatened if they could not swim upriver to spawn. This, in turn, could affect the fishing industry. In addition, some land would be permanently flooded to protect other areas from occasional floods.

How might this problem or similar ones be resolved? Individuals and groups such as conservationists, farmers, and others may try to influence governmental decisions. This is called lobbying. Sometimes, legal challenges are made to a planned development. Other times, a group of citizens will force a vote on the issue. This allows the public to decide. Can you think of other ways to resolve difficult environmental issues?

**READING CHECK:** ***Environment and Society*** How can people with different points of view on environmental issues influence decision making?

# Section 3 Review

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Keyword: SW3 HP2

### Define

atmosphere
lithosphere
hydrosphere
biosphere
environment

### Reading for the Main Idea

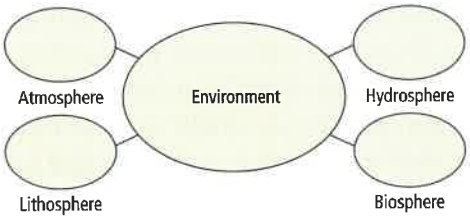
1. ***Physical Systems*** How are Earth's four spheres connected to form a system?
2. ***Environment and Society*** How do different points of view on environmental issues influence public policies and decision-making processes? Give an example.

### Critical Thinking

3. **Drawing Inferences and Conclusions** How does the atmosphere affect the other spheres?
4. **Making Generalizations and Predictions** How can human activities affect the Earth system?

### Organizing What You Know

5. Copy the graphic organizer below. Use it to describe each of Earth's four spheres. In the center, describe ways the four spheres interrelate to influence Earth's environment.



# Geography for Life

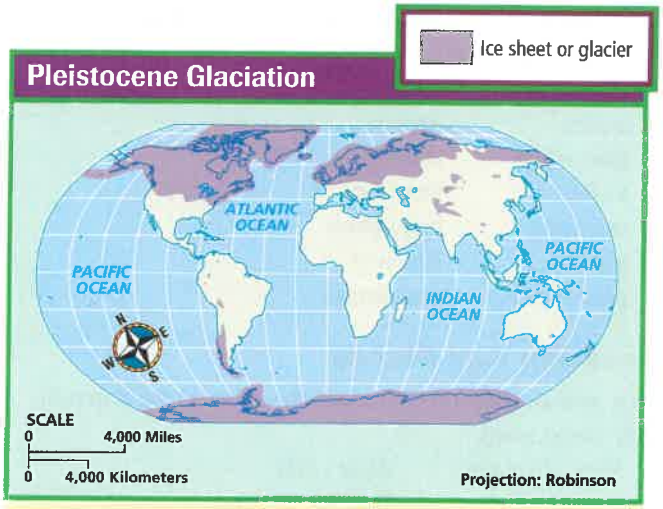
## Ice Ages and the Earth System

Throughout this textbook you will read about the forces and processes that have shaped the Earth system. Among the most important of these processes were Earth's ice ages. Ice ages are long periods of time during which thick ice sheets cover vast areas of land. During the ice ages, Earth's temperatures cooled for thousands or even millions of years, and ice sheets spread across the planet. During the most recent ice age, which ended about 10,000 years ago, ice sheets covered almost one third of Earth's present land area. (See the map of Pleistocene Glaciation.) Earth is currently experiencing a warm period between ice ages.

Ice ages greatly affect Earth's hydrosphere. For example, water from the oceans is frozen and locked in the expanding ice sheets. During the most recent ice age, enough water was frozen to lower global sea levels some 300 to 400 feet (90 to 120 m). As a result, more land was exposed at Earth's surface. The shapes and locations of coastlines differed greatly from how they look today. For example, the British Isles and mainland Europe were connected. North America and Asia were joined across what is now the Bering Strait. Rising ocean waters eventually covered those land bridges, however. Ocean levels rose because the warm period between ice ages causes ice to melt and ocean levels to rise. In fact, this process is partly responsible for the gradual rise in ocean levels today.

Some of the effects that ice ages have had on Earth's landscapes are easy to see. Slowly moving ice sheets carved and scraped the lithosphere, removing soil and forming holes. When the ice melted some of these holes filled with water and became lakes and swamps. The Great Lakes were formed in this way. Moving ice also wore down mountains and created great valleys.

In addition to their effects on the hydrosphere and lithosphere, ice ages also affected Earth's atmosphere and biosphere. Colder temperatures caused shifts in wind patterns. Ice-age temperature changes also caused a major redistribution of plants and animals. For example, expanding ice shifted the habitats of plant and animal species in the Northern Hemisphere from north to south. As a result, many species died off. During the last ice age, the distribution of human populations also changed. Most researchers believe that a land bridge across the Bering Strait allowed humans to move from eastern Asia to the Americas. Humans also moved across land links between areas in Europe, Asia, and Australia.




**INTERPRETING THE MAP** *The most recent ice age occurred mainly during the Pleistocene Epoch. This epoch began about 2 million years ago and ended about 10,000 years ago. Therefore, this ice age is known as the Pleistocene Ice Age, or Pleistocene Glaciation. During the Pleistocene Glaciation there were perhaps 12–16 periods of major ice advances. Between these cold periods were warmer times called interglacials.* ***Which parts of the world were covered with ice during the Pleistocene Glaciation?***

### Applying What You Know

1. **Summarizing** In what ways did ice ages affect the Earth system? How can some of those effects be seen today?
2. **Analyzing Information** In what ways might a new ice age affect Earth's biosphere?

# CHAPTER 2 Review

**HOLT**

## Geography's Impact Video Series

Review the video to answer the closing question: *What is a CME, and why is it important to be able to predict when one might happen?*

## Building Vocabulary

On a separate sheet of paper, explain the following terms by using them correctly in sentences.

| | |
|---|---|
| solar system | solstice |
| planets | equinox |
| solar energy | atmosphere |
| rotation | lithosphere |
| revolution | hydrosphere |
| tropics | biosphere |
| polar regions | environment |

## Locating Key Places

On a separate sheet of paper, match the letters on the map with their correct labels.

| | |
|---|---|
| Tropic of Cancer | Arctic Circle |
| Antarctic Circle | Tropic of Capricorn |


## Understanding the Main Ideas

### Section 1

1. *Physical Systems* What term describes Earth's shape?
2. *Physical Systems* How long does it take Earth to make one complete rotation on its axis? One complete revolution around the Sun?

### Section 2

3. *Physical Systems* When do the Sun's most direct rays strike in the Northern Hemisphere? What effect does this have on temperatures there?
4. *Physical Systems* During the solstices, where do Earth's poles point in relation to the Sun?

### Section 3

5. *Physical Systems* What is the Earth system?

## Thinking Critically

1. **Drawing Inferences and Conclusions** Suppose all you knew about a place was that it was located at 60° north latitude. What would this tell you about how much solar energy the place receives each year?
2. **Identifying Cause and Effect** How do Earth's revolution and tilt cause seasons?
3. **Making Generalizations and Predictions** If you lived in an area near the equator, would you experience all of the seasons? Explain.

## Using the Geographer's Tools

1. **Analyzing Diagrams** Study the diagram of the seasons in Section 2. What is today's date? Using the diagram, estimate where Earth is on its path around the Sun.
2. **Interpreting Maps** Study the World Time Zones map that follows Section 2. Suppose a ship left Honolulu, Hawaii, at 10:00 P.M. on December 5 and traveled to Auckland, New Zealand. If the trip lasted six hours, what date and time would the ship arrive in Auckland?
3. **Preparing Diagrams** Using the information in this chapter, draw a diagram of Earth showing it tilted on its axis. Draw and label major lines of latitude, such as the equator, Tropics of Cancer and Capricorn, and Arctic and Antarctic Circles. How many degrees of latitude separate the Tropics of Cancer and Capricorn?

## Writing about Geography

Imagine you have been asked to help search for life beyond Earth. Write a short proposal outlining where you will search for life, what technologies you will use, and what you hope to find. When you are finished with your proposal, proofread it to make sure you have used standard grammar, spelling, sentence structure, and punctuation.

SKILL BUILDING

## Geography for Life

**Preparing Sketch Maps**

*Places and Regions* Find a detailed surface map of the Moon from an atlas or other source. Use it to prepare a sketch map of the Moon's surface features and topography. When you are done, compare your map to a world map of Earth. What features are common on the Moon but not on Earth? How is the surface of the Moon different from the surface of Earth?

## Building Social Studies Skills

**Sunrise and Sunset Times for Selected 2001 Dates in Sydney, Australia**

| Date | Sunrise | Sunset |
|---|---|---|
| March 21 | 6:59 A.M. | 7:06 P.M. |
| June 21 | 6:58 A.M. | 4:56 P.M. |
| September 22 | 5:45 A.M. | 5:51 P.M. |
| December 21 | 5:43 A.M. | 8:03 P.M. |

### Interpreting Charts

Study the chart above. Then use the information in the chart to help you answer the questions that follow.

1. On which date does summer begin in Sydney, Australia?
   a. March 21
   b. June 21
   c. September 22
   d. December 21
2. Look carefully at the times listed in the chart. How does this information relate to the tilt of Earth on its axis?

### Analyzing Secondary Sources

Read the following passage and answer the questions.

**"Telescopes have become central to astronomy. With the development of space-age technology, astronomy made even greater advances. For example, scientists sent out probes to collect new information about planets, moons, and other objects. The Hubble Space Telescope, built between 1978 and 1990, led to many exciting discoveries. The Hubble is the first powerful telescope ever placed in orbit around Earth, which gives it a much clearer view of space. Astronomers have used the Hubble to study black holes, galaxies, stars, and other distant objects."**

3. The Hubble Space Telescope
   a. was built in the late 1800s.
   b. is located in Hawaii.
   c. is a probe sent out to study Mars.
   d. is the first powerful telescope ever placed in orbit around Earth.
4. Why might the Hubble's location give it such a clear view of space?

## Alternative Assessment

PORTFOLIO ACTIVITY

### Learning about Your Local Geography

**Individual Project: Research**

Plan, organize, and complete a research project on an environmental issue in your community. Check your local newspaper to find a current environmental issue. Then write a summary that explains what the issue is and describes different points of view about it. How might this issue be resolved? What role does public policy play in this issue? Have citizens tried to influence public policy regarding this issue? If so, how? How might a geographical perspective be used to help resolve this issue?

internet connect

**Internet Activity: go.hrw.com**
**KEYWORD: SW3 GT2**

Choose a topic on Earth in space to:

- investigate the cause of seasons.
- explore recycling methods and create an action plan.
- report on the south polar regions and conditions in Antarctica.