

# Earth in Space

## Reading Preview

### Key Concepts

- How does Earth move in space?
- What causes the cycle of seasons on Earth?

### Key Terms

- astronomy • axis • rotation
- revolution • orbit • solstice
- equinox



## Target Reading Skill

**Using Prior Knowledge** Your prior knowledge is what you already know before you read about a topic. Before you read, write what you know about seasons on Earth in a graphic organizer like the one below. As you read, write in what you learn.

What You Know
1. The sun's rays heat Earth.
2.

What You Learned
1.
2.

FIGURE 1

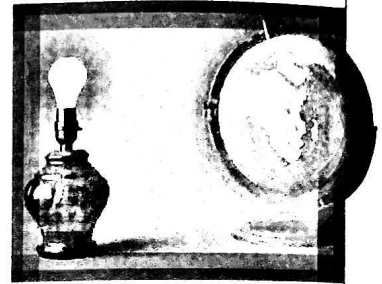
**Ancient Egyptian Farmers**  
Egyptian farmers watched the sky in order to be prepared to plow and plant their fields.

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## Discover Activity

### What Causes Day and Night?

1. Place a lamp with a bare bulb on a table to represent the sun. Put a globe at the end of the table about 1 meter away to represent Earth.
2. Turn the lamp on and darken the room. Which parts of the globe have light shining on them? Which parts are in shadow?
3. Find your location on the globe. Turn the globe once. Notice when it is lit—day—at your location and when it is dark—night.



### Think It Over

**Making Models** What does one complete turn of the globe represent? In this model, how many seconds represent one day? How could you use the globe and bulb to represent a year?

Each year, ancient Egyptian farmers eagerly awaited the flood of the Nile River. For thousands of years, their planting was ruled by it. As soon as the Nile's floodwaters withdrew, the farmers had to be ready to plow and plant their fields along the river. Therefore, the Egyptians wanted to predict when the flood would occur. Around 3000 B.C., people noticed that the bright star Sirius first became visible in the early morning sky every year shortly before the flood began. The Egyptians used this knowledge to predict each year's flood. The ancient Egyptians were among the first people to study the stars. The study of the moon, stars, and other objects in space is called **astronomy**.



# How Earth Moves

Ancient astronomers studied the movements of the sun and the moon as they appeared to travel across the sky. It seemed to them as though Earth was standing still and the sun and moon were moving. Actually, the sun and moon seem to move across the sky each day because Earth is rotating on its axis. Earth also moves around the sun. **Earth moves through space in two major ways: rotation and revolution.**

**Rotation** The imaginary line that passes through Earth's center and the North and South poles is Earth's **axis**. The spinning of Earth on its axis is called **rotation**.

Earth's rotation causes day and night. As Earth rotates eastward, the sun appears to move westward across the sky. It is day on the side of Earth facing the sun. As Earth continues to turn to the east, the sun appears to set in the west. Sunlight can't reach the side of Earth facing away from the sun, so it is night there. It takes Earth about 24 hours to rotate once. As you know, each 24-hour cycle of day and night is called a day.

**Revolution** In addition to rotating on its axis, Earth travels around the sun. **Revolution** is the movement of one object around another. One complete revolution of Earth around the sun is called a year. Earth follows a path, or **orbit**, as it revolves around the sun. Earth's orbit is not quite circular. It is a slightly elongated circle, or ellipse.



**FIGURE 2**  
**Rotation**

The rotation of Earth on its axis is similar to the movement of the figure skater as she spins.



**FIGURE 3**

## **Revolution**

Earth revolves around the sun just as a speed skater travels around the center of a rink during a race. **Applying Concepts** What is one complete revolution of Earth around the sun called?

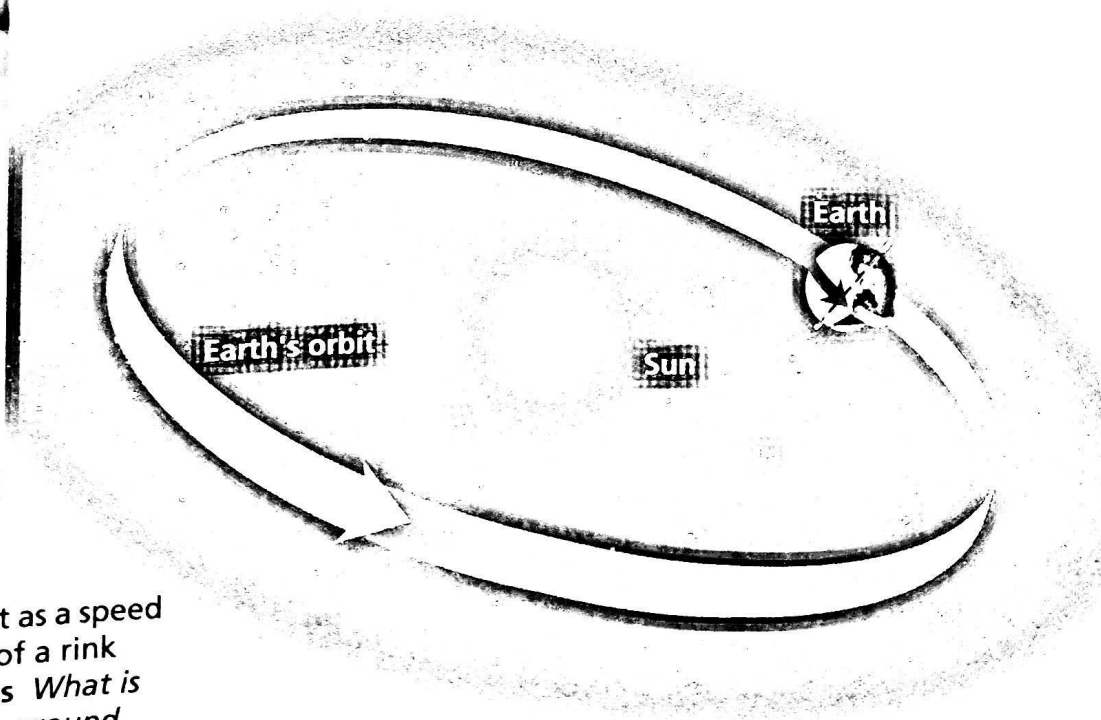
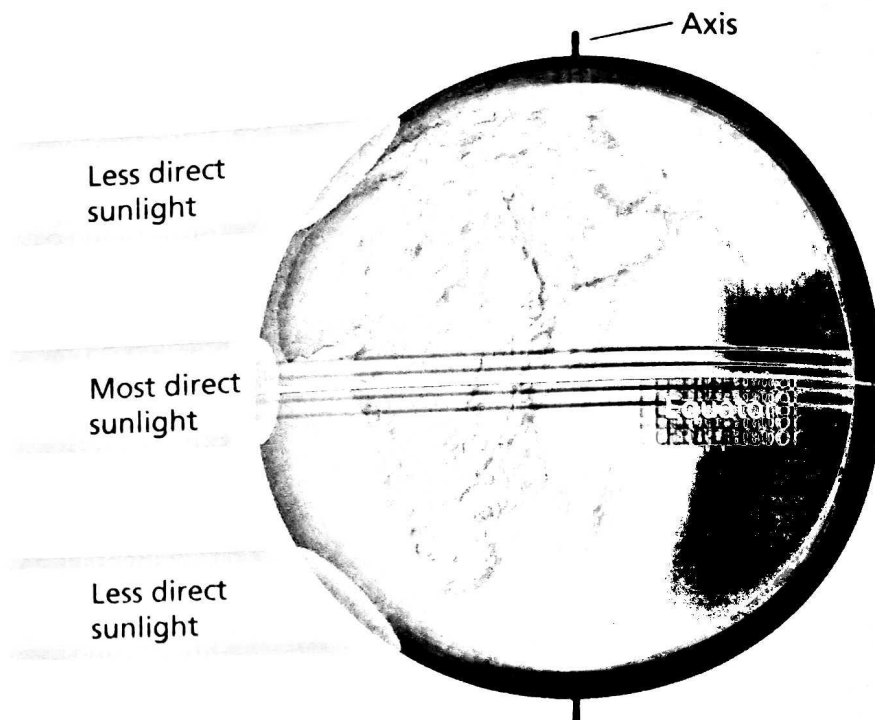


FIGURE 4

### Sunlight Striking Earth's Surface

Near the equator, sunlight strikes Earth's surface more directly and is less spread out than near the poles. **Relating Cause and Effect** *Why is it usually colder near the poles than near the equator?*



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### Try This Activity

#### Sun Shadows

The sun's shadow changes predictably through the day.

1. On a sunny day, stand outside in the sun and use a compass to find north.
2. Have your partner place a craft stick about one meter to the north of where you are standing. Repeat for east, south, and west.
3. Insert a meter stick in the ground at the center of the craft sticks. Make sure the stick is straight up.
4. Predict how the sun's shadow will move throughout the day.
5. Record the direction and length of the sun's shadow at noon and at regular intervals during the day.

**Predicting** How did the actual movement of the sun's shadow compare with your prediction? How do you think the direction and length of the sun's shadow at these same times would change over the next six months?

## The Seasons on Earth

Most places outside the tropics and polar regions have four distinct seasons: winter, spring, summer, and autumn. But there are great differences in temperature from place to place. For instance, it is generally warmer near the equator than near the poles. Why is this so?

**How Sunlight Hits Earth** Figure 4 shows how sunlight strikes Earth's surface. Notice that sunlight hits Earth's surface most directly near the equator. Near the poles, sunlight arrives at a steep angle. As a result, it is spread out over a greater area. That is why it is warmer near the equator than near the poles.

**Earth's Tilted Axis** If Earth's axis were straight up and down relative to its orbit, temperatures would remain fairly constant year-round. There would be no seasons. **Earth has seasons because its axis is tilted as it revolves around the sun.**

Notice in Figure 5 that Earth's axis is always tilted at an angle of  $23.5^\circ$  from the vertical. As Earth revolves around the sun, the north end of its axis is tilted away from the sun for part of the year and toward the sun for part of the year.

Summer and winter are caused by Earth's tilt as it revolves around the sun. The change in seasons is not caused by changes in Earth's distance from the sun. In fact, Earth is farthest from the sun when it is summer in the Northern Hemisphere.



Reading  
Checkpoint

When is Earth farthest from the sun?

## FIGURE 5 The Seasons

The yearly cycle of the seasons is caused by the tilt of Earth's axis as it revolves around the sun.

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### June Solstice

The north end of Earth's axis is tilted toward the sun. It is summer in the Northern Hemisphere and winter in the Southern Hemisphere.

### March Equinox



### June Solstice

### December Solstice

### December Solstice

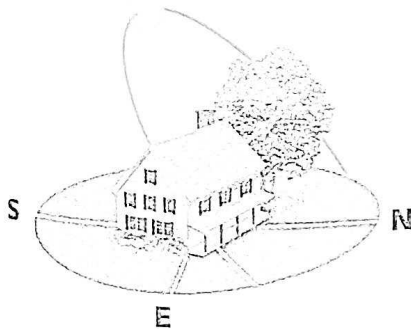
The south end of Earth's axis is tilted toward the sun. It is summer in the Southern Hemisphere and winter in the Northern Hemisphere.

### March and September Equinoxes

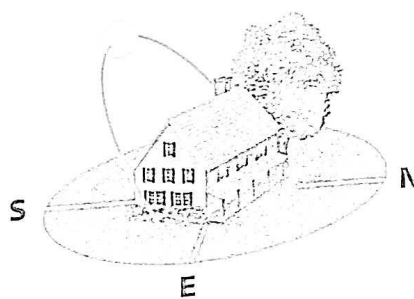
Neither end of Earth's axis is tilted toward the sun. Both hemispheres receive the same amount of energy.

### September Equinox

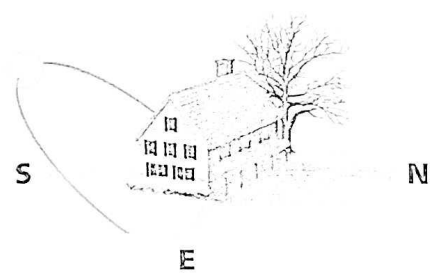
The height of the sun above the horizon varies with the season.  
Interpreting Diagrams *When is the sun at its maximum height in the Northern Hemisphere?*



### June Solstice



### March and September Equinoxes



### December Solstice



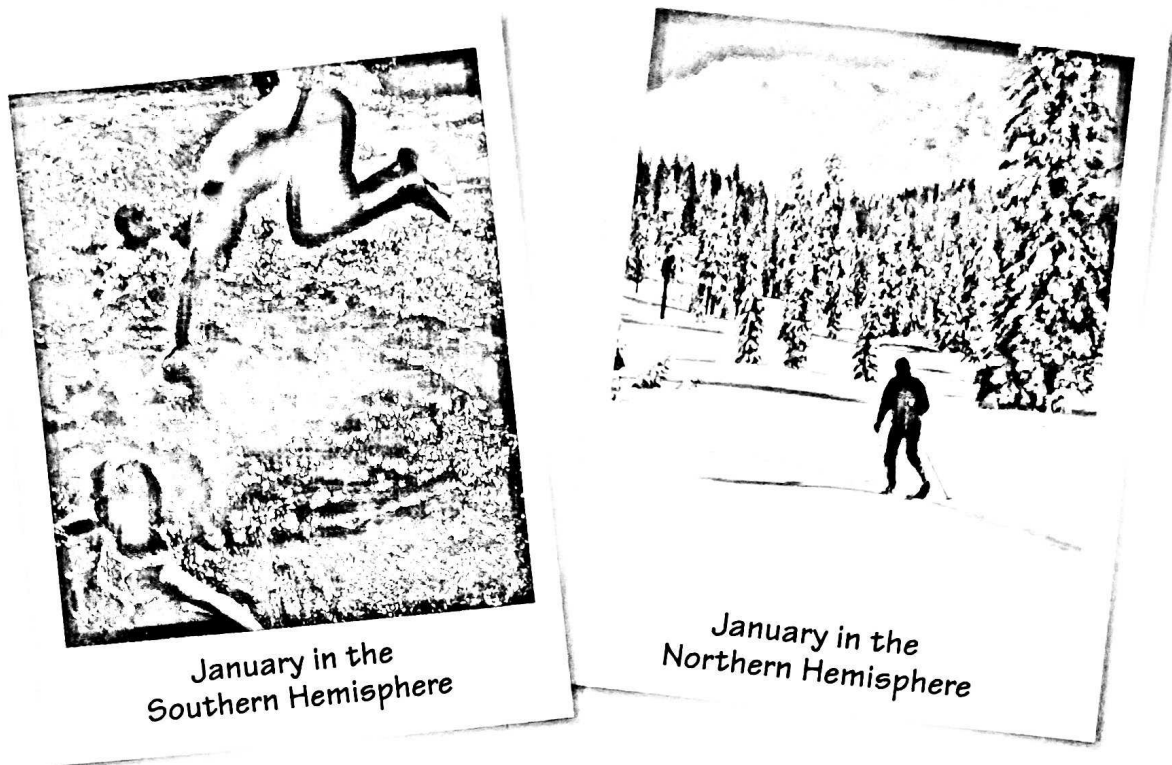


FIGURE 6

## Solstices and Equinoxes

Summer in the Southern Hemisphere (left) occurs at the same time as winter in the Northern Hemisphere (right).

Similarly, when it is spring in the Southern Hemisphere, it is fall in the Northern Hemisphere.

**Interpreting Photographs** In which direction was Earth's axis pointing at the time that each of the photographs was taken?

**Earth in June** In June, the north end of Earth's axis is tilted toward the sun. In the Northern Hemisphere, the noon sun is high in the sky and there are more hours of daylight than darkness. The combination of direct rays and more hours of sunlight heats the surface more in June than at any other time of the year. It is summer in the Northern Hemisphere.

At the same time south of the equator, the sun's energy is spread over a larger area. The sun is low in the sky and days are shorter than nights. The combination of less direct rays and fewer hours of sunlight heats Earth's surface less than at any other time of the year. It is winter in the Southern Hemisphere.

**Earth in December** In December, people in the Southern Hemisphere receive the most direct sunlight, so it is summer there. At the same time, the sun's rays in the Northern Hemisphere are more slanted and there are fewer hours of daylight. So it is winter in the Northern Hemisphere.

**Solstices** The sun reaches its greatest distance north or south of the equator twice each year. Each of these days, when the sun is farthest north or south of the equator, is known as a **solstice** (SOHL stis). The day when the sun is farthest north of the equator is the summer solstice in the Northern Hemisphere. It is also the winter solstice in the Southern Hemisphere. This solstice occurs around June 21 each year. It is the longest day of the year in the Northern Hemisphere and the shortest day of the year in the Southern Hemisphere.

Similarly, around December 21, the sun is farthest south of the equator. This is the winter solstice in the Northern Hemisphere and the summer solstice in the Southern Hemisphere.



October in the  
Southern Hemisphere



October in the  
Northern Hemisphere

**Equinoxes** Halfway between the solstices, neither hemisphere is tilted toward or away from the sun. This occurs twice a year, when the noon sun is directly overhead at the equator. Each of these days is known as an **equinox**, which means “equal night.” During an equinox, day and night are each about 12 hours long everywhere on Earth. The vernal (spring) equinox occurs around March 21 and marks the beginning of spring in the Northern Hemisphere. The autumnal equinox occurs around September 22. It marks the beginning of fall in the Northern Hemisphere.



Reading  
Checkpoint

What is an equinox?

## Section 1 Assessment

**Target Reading Skill Using Prior Knowledge** Review your graphic organizer and revise it based on what you just learned in this section. Use it to help answer Question 2.

### Reviewing Key Concepts

1. a. **Identifying** What are the two major motions of Earth as it travels through space?
- b. **Explaining** Which motion causes day and night?
2. a. **Relating Cause and Effect** What causes the seasons?
- b. **Comparing and Contrasting** What are solstices and equinoxes? How are they related to the seasons?
- c. **Predicting** How would the seasons be different if Earth were not tilted on its axis?

### Writing in Science

**Descriptive Paragraph** What seasons occur where you live? Write a detailed paragraph describing the changes that take place each season in your region. Explain how seasonal changes in temperature and hours of daylight relate to changes in Earth's position as it moves around the sun.