

Earth's Days, Years, and Seasons

ESSENTIAL QUESTION

How are Earth's days, years, and seasons related to the way Earth moves in space?

By the end of this lesson, you should be able to relate Earth's days, years, and seasons to Earth's movement in space.

In many parts of the world, blooming flowers are one of the first signs that spring has arrived. Spring flowers start blooming with the warmer temperatures of spring, even if there is still snow on the ground.

Lesson Labs

- Quick Labs**
- Earth's Rotation and Revolution
 - Seasons Model
- Field Lab**
- Sunlight and Temperature



2 Apply Write your own caption for this photo of leaves in the space below.

Engage Your Brain

1 Predict Check T or F to show whether you think each statement is true or false.

- | T | F | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | A day is about 12 hours long. |
| <input type="checkbox"/> | <input type="checkbox"/> | A year is about 365 days long. |
| <input type="checkbox"/> | <input type="checkbox"/> | When it is summer in the Northern Hemisphere, it is summer all around the world. |

Active Reading

3 Synthesize The term *rotation* can be tricky to remember because it is used somewhat differently in science than it is in everyday life. In baseball, a pitching *rotation* lists the order of a team's starting pitchers. The order starts over after the last pitcher on the list has played. On the lines below, write down any other examples you can think of that use the term *rotation*.

rotation:

Vocabulary Terms

- | | |
|--------------|------------|
| • rotation | • season |
| • day | • equinox |
| • revolution | • solstice |
| • year | |

4 Apply As you learn the definition of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

Spinning in Circles

What determines the length of a day?

Active Reading

5 Identify As you read, underline the places on Earth's surface at which the ends of Earth's axis would be.

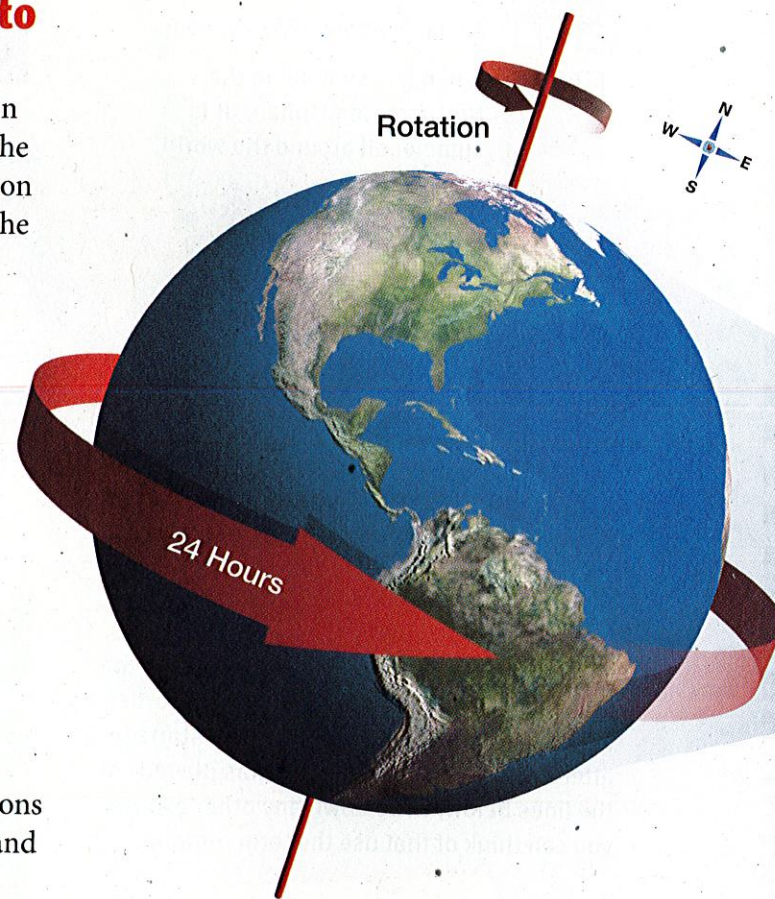
Each planet spins on its axis. Earth's axis (ACK•sis) is an imaginary straight line that runs from the North Pole to the South Pole. The spinning of a body, such as a planet, on its axis is called **rotation**. The time it takes a planet to complete one full rotation on its axis is called a **day**.

The Time It Takes for Earth to Rotate Once

Earth rotates in a counterclockwise motion around its axis when viewed from above the North Pole. This means that as a location on Earth's equator rotates from west to east, the sun appears to rise in the east. The sun then appears to cross the sky and set in the west.

As Earth rotates, only one-half of Earth faces the sun at any given time. People on the half of Earth facing the sun experience daylight. This period of time in daylight is called *daytime*. People on the half of Earth that faces away from the sun experience darkness. This period of time in darkness is called *nighttime*.

Earth's rotation is used to measure time. Earth completes one rotation on its axis in 24 hours, or in one day. Most locations on Earth's surface move through daylight and darkness in that time.



Earth's motion is used to measure the length of an Earth day.

What determines the length of a year?

As Earth rotates on its axis, Earth also revolves around the sun. Although you cannot feel Earth moving, it is traveling around the sun at an average speed of nearly 30 km/s. The motion of a body that travels around another body in space is called **revolution** (reh•vuh•LOO•shun). Earth completes a full revolution around the sun in $365 \frac{1}{4}$ days, or about one **year**. We have divided the year into 12 months, each month lasting from 28 to 31 days.

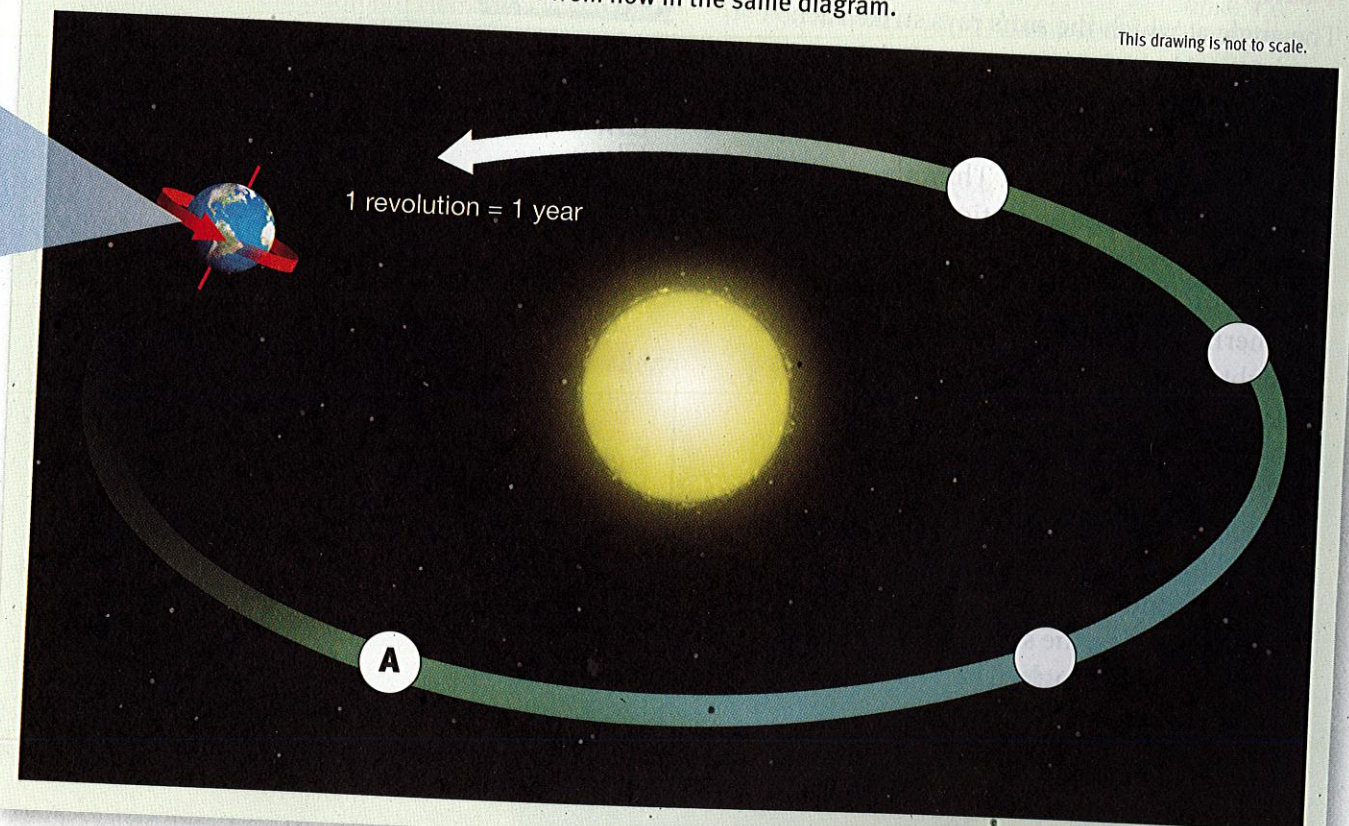
Earth's orbit is not quite a perfect circle. In January, Earth is about 2.5 million kilometers closer to the sun than it is in July. You may be surprised that this distance makes only a tiny difference in temperatures on Earth.

Think Outside the Book

6 Infer How is a leap year, in which a day is added to every fourth year, related to the time it takes Earth to revolve around the sun?

Visualize It!

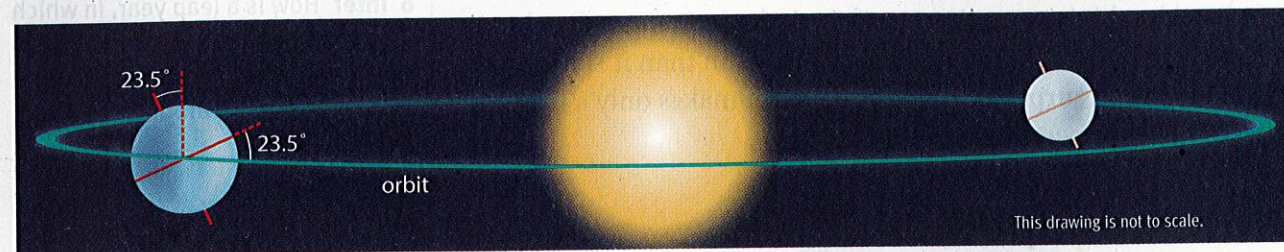
7 Apply Imagine that Earth's current position is at point A below. Write the label B to show Earth's position 6 months from now in the same diagram.



Tilt-a-Whirl

What conditions are affected by the tilt of Earth's axis?

Earth's axis is tilted at 23.5° . Earth's axis always points toward the North Star as Earth revolves around the sun. Thus, during each revolution, the North Pole may be tilted toward the sun or away from the sun, as seen below. When the North Pole is tilted toward the sun, the Northern Hemisphere (HEHM•ih•sfeer) has longer periods of daylight than does the Southern Hemisphere. When the North Pole is tilted away from the sun, the opposite is true.



The direction of tilt of Earth's axis remains the same throughout Earth's orbit around the sun.

Temperature

The angle at which the sun's rays strike each part of Earth's surface changes as Earth moves in its orbit. When the North Pole is tilted toward the sun, the sun's rays strike the Northern Hemisphere more directly. Thus, the region receives a higher concentration of solar energy and is warmer. When the North Pole is tilted away from the sun, the sun's rays strike the Northern Hemisphere less directly. When the sunlight is less direct, the solar energy is less concentrated and the region is cooler.

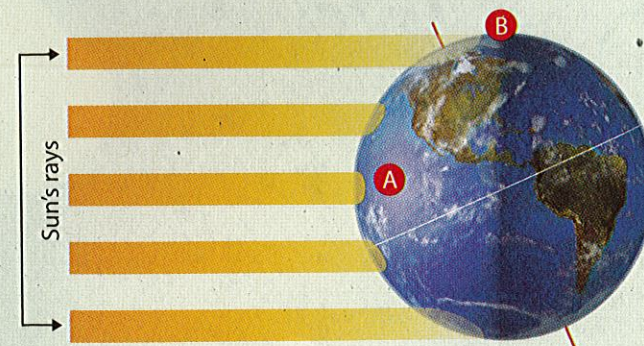
The spherical shape of Earth also affects how the sun warms up an area. Temperatures are high at point A in the diagram. This is because the sun's rays hit Earth's surface at a right angle and are focused in a small area. Toward the poles, the sun's rays hit Earth's surface at a lesser angle. Therefore, the rays are spread out over a larger area and the temperatures are cooler.

Visualize It!

8 Apply Which location on the illustration of Earth below receives more direct rays from the sun?

- ☐ A
- ☐ B
- ☐ They receive equal amounts.

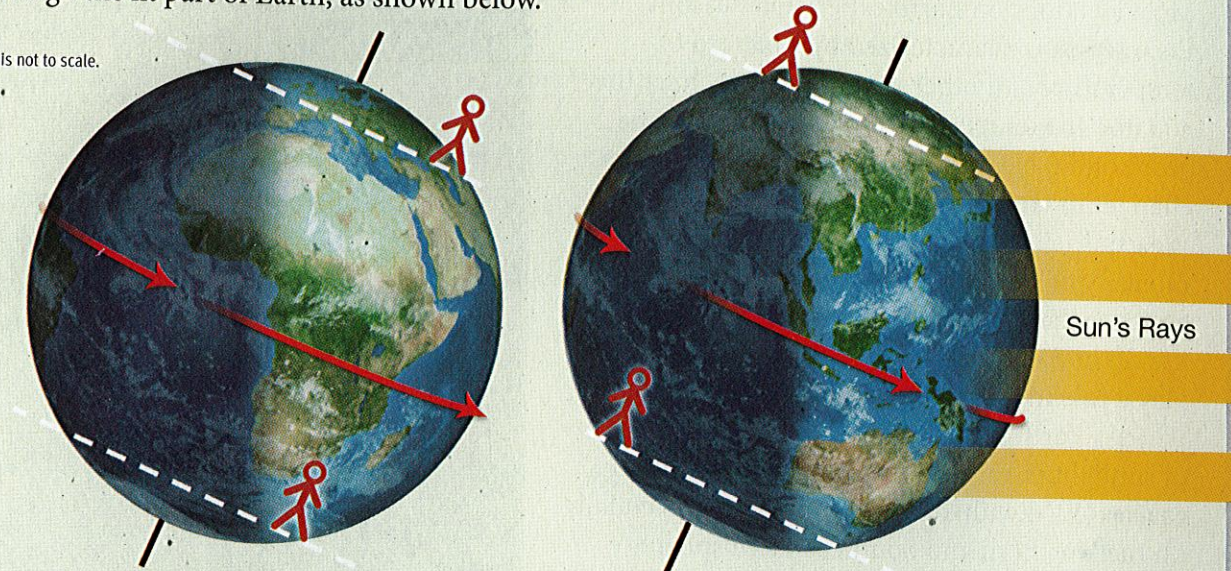
9 Identify Which location is cooler? _____



Daylight Hours

All locations on Earth experience an *average* of 12 hours of light a day. However, the *actual* number of daylight hours on any given day of the year varies with location. Areas around Earth's equator receive about 12 hours of light a day. Areas on Earth's surface that are tilted toward the sun have more hours of daylight. These areas travel a longer path through the lit part of Earth than areas at the equator. Areas on Earth's surface that are tilted away from the sun have less than 12 hours of light a day. These areas travel a shorter path through the lit part of Earth, as shown below.

This drawing is not to scale.



During summer in the Northern Hemisphere, a person has already had many daylight hours by the time a person in the Southern Hemisphere reaches daylight.

About twelve hours later, the person in the Northern Hemisphere is close to daylight again, while the person in the Southern Hemisphere still has many hours of darkness left.

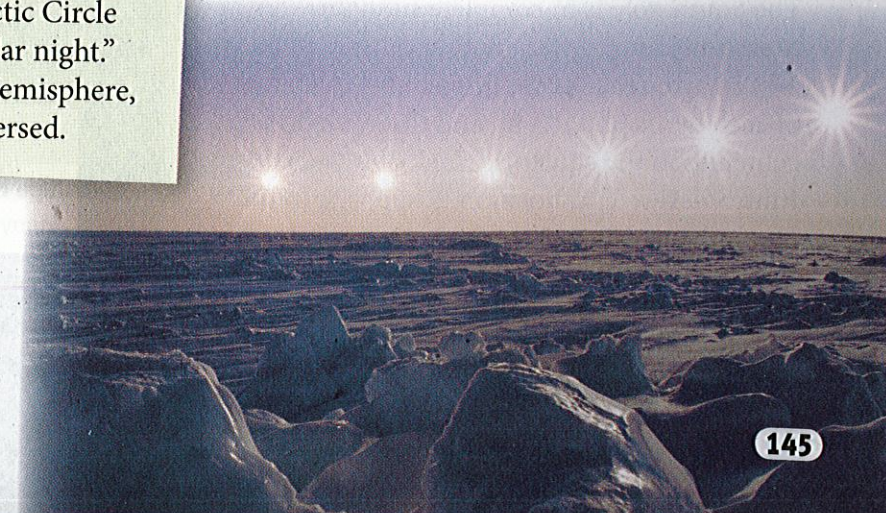
Midnight Sun

When it is summer in the Northern Hemisphere, the time in each day that it is light increases as you move north of the equator. Areas north of the Arctic Circle have 24 hours of daylight, called the "midnight sun," as seen in the photo. At the same time, areas south of the Antarctic Circle receive 24 hours of darkness, or "polar night." When it is winter in the Northern Hemisphere, conditions in the polar areas are reversed.

Visualize It! Inquiry

10 Synthesize Why isn't the area in the photo very warm even though the sun is up all night long?

This composite image shows that the sun never set on this Arctic summer day.



Seasons change...

What causes seasons?

Most locations on Earth experience seasons. Each **season** is characterized by a pattern of temperature and other weather trends. Near the equator, the temperatures are almost the same year-round. Near the poles, there are very large changes in temperatures from winter to summer. We experience seasons due to the changes in the intensity of sunlight and the number of daylight hours as Earth revolves around the sun. So, both the tilt of Earth's axis and Earth's spherical shape play a role in Earth's changing seasons.

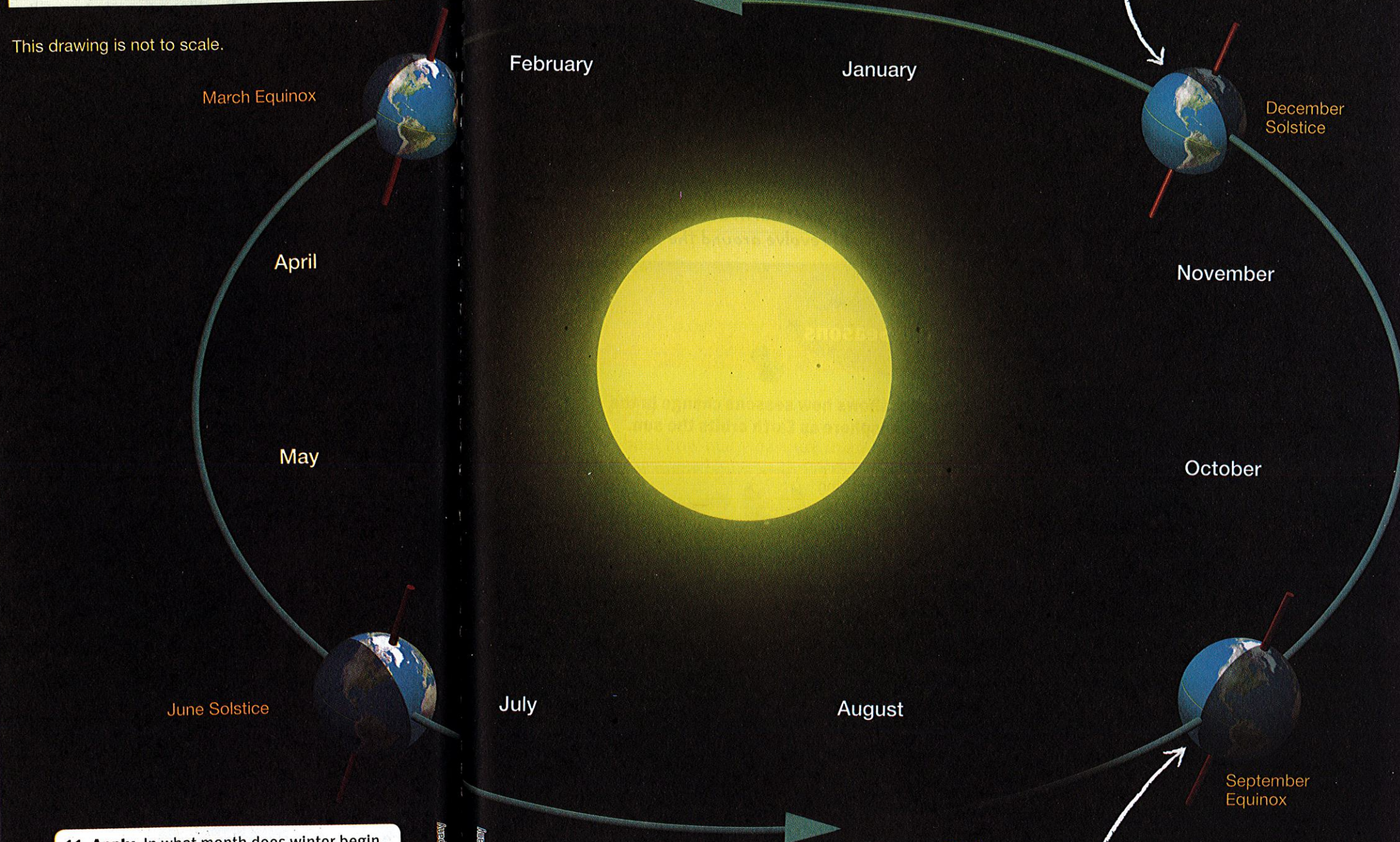
As Earth travels around the sun, the area of sunlight in each hemisphere changes. At an **equinox** (EE•kwuh•nahks), sunlight shines equally on the Northern and Southern Hemispheres. Half of each hemisphere is lit, and half is in darkness. As Earth moves along its orbit, the sunlight reaches more of one hemisphere than the other. At a **solstice** (SAHL•stis), the area of sunlight is at a maximum in one hemisphere and at a minimum in the other hemisphere.

- **September Equinox** When Earth is in this position, sunlight shines equally on both poles.
- **December Solstice** About three months later, Earth has traveled a quarter of the way around the sun, but its axis still points in the same direction into space. The North Pole leans away from the sun and is in complete darkness. The South Pole is in complete sunlight.
- **March Equinox** After another quarter of its orbit, Earth reaches another equinox. Half of each hemisphere is lit, and the sunlight is centered on the equator.
- **June Solstice** This position is opposite to the December solstice. Now the North Pole leans toward the sun and is in complete sunlight, and the south pole is in complete darkness.

Visualize It!

The amount of sunlight an area on Earth receives changes during the year. These changes are due to Earth's tilt and position in its orbit around the sun. Equinoxes and solstices mark certain points in the range of sunlight each of Earth's hemispheres receives.

This drawing is not to scale.



11 Apply In what month does winter begin in the Southern Hemisphere?

12 Infer During which solstice would the sun be at its highest point in the sky in the Northern Hemisphere?

Solstices

The seasons of summer and winter begin on days called *solstices*. Each year on June 21 or 22, the North Pole's tilt toward the sun is greatest. This day is called the *June solstice*. This solstice marks the beginning of summer in the Northern Hemisphere. By December 21 or 22, the North Pole is tilted to the farthest point away from the sun. This day is the December solstice.

Equinoxes

The seasons fall and spring begin on days called *equinoxes*. The hours of daylight and darkness are approximately equal everywhere on Earth on these days. The *September equinox* occurs on September 22 or 23 of each year. This equinox marks the beginning of fall in the Northern Hemisphere. The *March equinox* on March 20 or 21 of each year marks the beginning of spring.

13 Infer In which parts of the world is an equinox most different from other days of the year?

Visual Summary

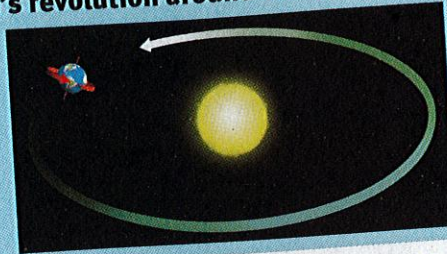
To complete this summary, circle the correct word. Then use the key below to check your answers. You can use this page to review the main concepts of the lesson.

The length of a day is determined by Earth's rotation.



14 It takes Earth 24 seconds/hours to make one rotation on its axis.

The length of a year is determined by Earth's revolution around the sun.



15 It takes Earth about 365 hours/days to revolve around the sun.

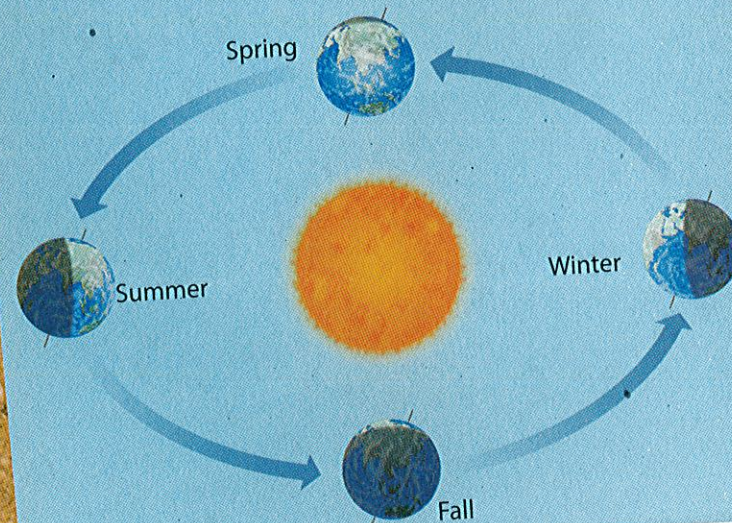
Earth's Days, Years, and Seasons

Earth's tilt affects temperatures and daylight hours at different locations on Earth.



16 Earth's temperatures and hours of daylight stay the most constant at the equator/poles.

This diagram shows how seasons change in the Northern Hemisphere as Earth orbits the sun.



17 When it is summer in the Northern Hemisphere, it is summer/winter in the Southern Hemisphere.

18 Predict How would conditions on Earth change if Earth stopped rotating on its axis?

Lesson Review

Vocabulary

In the space provided below, describe how each set of words are related.

1 revolution, year

2 rotation, day

3 season, equinox, solstice

Key Concepts

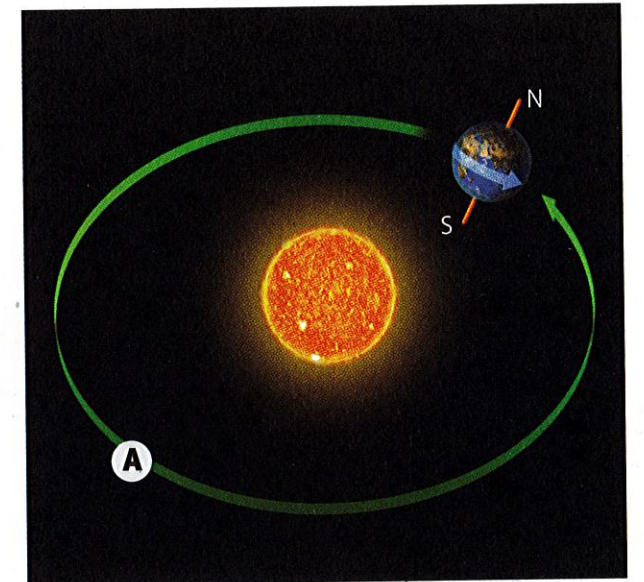
4 Identify About how many days are in an Earth year? And how many hours in an Earth day?

5 Describe How does the tilt of Earth's axis affect how the sun's rays strike Earth?

6 Synthesize How does the tilt of Earth's axis affect the number of daylight hours and the temperature of a location on Earth?

Critical Thinking

Use this image to answer the questions below.



This drawing is not to scale.

7 Identify What season is the Northern Hemisphere experiencing in the image above?

8 Explain How do the tilt of Earth's axis and Earth's movements around the sun cause seasons?

9 Describe If the Earth moves to point A in the image above, what season will the Northern Hemisphere experience?