Solstices

Distances north and south of the equator are measured as degrees of **latitude.** The equator is zero degrees latitude. Because Earth is tilted on its axis, the Sun's position relative to the equator is always changing. The **solstices** are the two times of the year when the Sun's direct rays strike Earth the farthest north or south of the equator.

On June 20 or 21, Earth passes through a point in its orbit called the *summer solstice* (Figure 14). At this time, the Northern Hemisphere is tilted directly toward the Sun. The Sun appears overhead at 23.5 degrees north of the equator, the Tropic of Cancer. It is the Northern Hemisphere's first day of summer. It is also the longest period of daylight. The Southern Hemisphere is tilted directly away from the Sun at this time, so it is the first day of winter there.

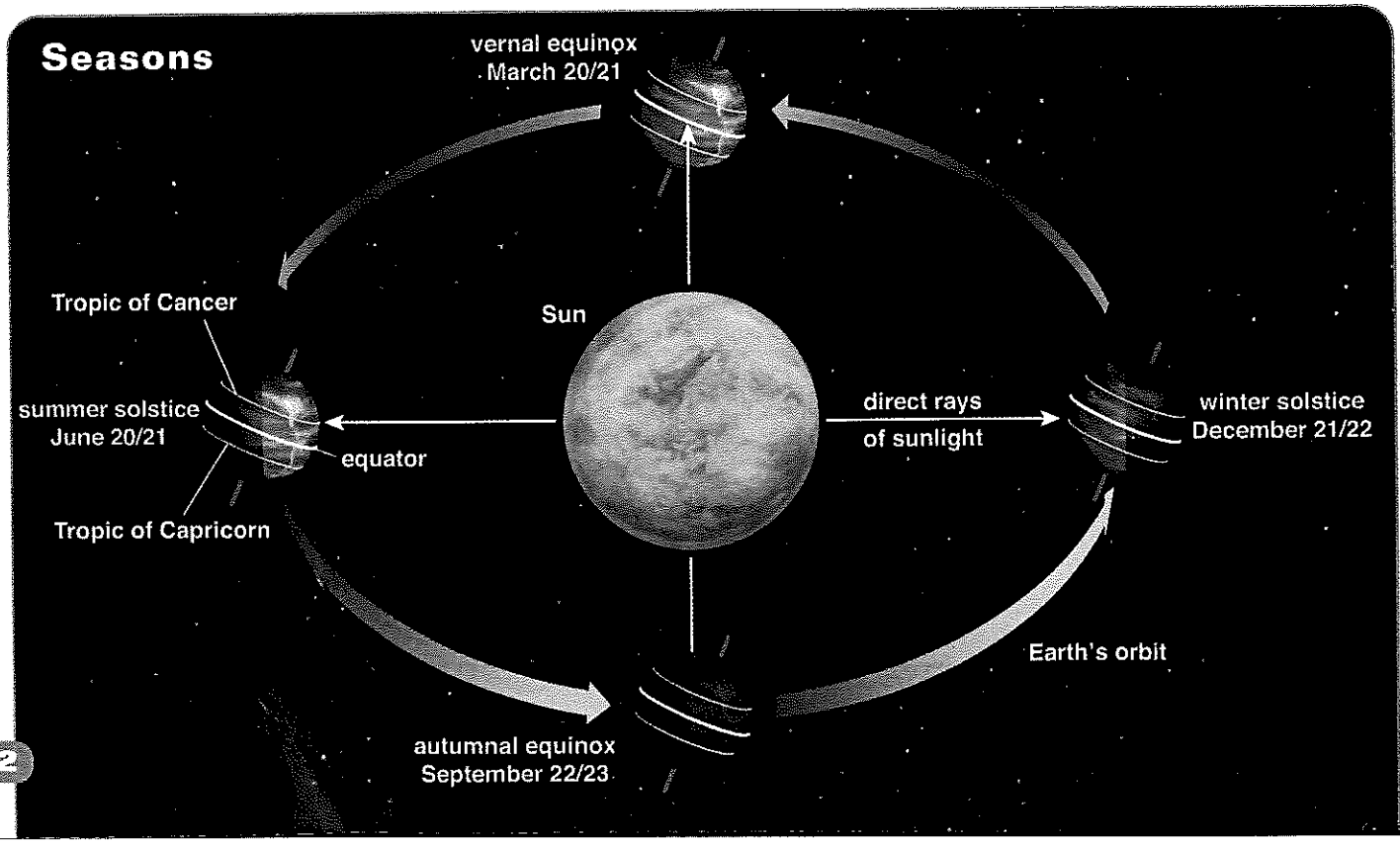
On December 21 or 22, Earth reaches the *winter solstice.* At this time, the Northern Hemisphere is tilted directly away from the Sun. The Sun appears overhead at 23.5 degrees south of the equator, the Tropic of Capricorn. It is the Northern Hemisphere's first day of winter. It is also the day with the shortest period of daylight. But in the Southern Hemisphere, it is the day with the longest period of daylight and the start of summer.

Equinoxes

Twice a year, between the solstices, the Sun's rays strike the equator directly. When this happens, day and night are equal in length everywhere on Earth. Both hemispheres have 12 hours of daylight and 12 hours of darkness. These two days are called **equinoxes,** from the Latin word for "equal night."

The *vernal equinox* occurs on March 20 or 21, marking the beginning of spring in the Northern Hemisphere. The *autumnal equinox* occurs on September 22 or 23, marking the beginning of autumn in the Northern Hemisphere. In the Southern Hemisphere, the seasons are the opposite. So in the Southern Hemisphere, March 20 or 21 is the start of autumn and September 22 or 23 is the start of spring.

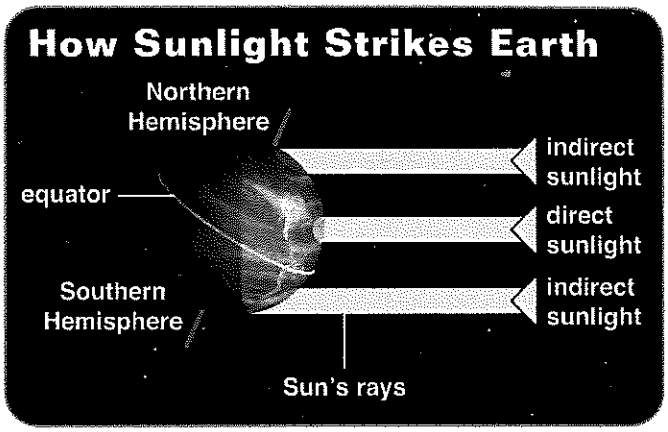
▼ **Figure 14** Due to Earth's axial tilt, the Sun's position relative to the equator changes throughout the year. What season is it in the Northern Hemisphere when the Sun's direct rays strike the Tropic of Capricorn?



What Causes Seasons?

Earth's revolution around the Sun takes 365.25 days. During that one-year period, Earth's weather patterns change in a regular, predictable cycle. Spring, summer, autumn, and winter are the four main divisions of the year that we call **seasons.**

You might think that the seasons are caused by Earth's changing distance from the Sun due to Earth's elliptical orbit. But this is not true. The difference in the distance to the Sun at different points on the ellipse is very small, not enough to cause a major change in the weather. We have different seasons because Earth's axis is tilted 23.5 degrees. This tilt is called Earth's **axial tilt.** As Earth travels in its orbit around the Sun, Earth's axial tilt stays the same. This makes Earth's North and South Poles point toward or away from the Sun at different times of the year.



▲ **Figure 13** As Earth revolves around the Sun, Earth's axial tilt causes one hemisphere to receive more direct sunlight than the other. In direct sunlight, solar energy is concentrated onto a smaller area. In indirect sunlight, the same amount of solar energy is spread out over a larger area.

The summer season in the Northern Hemisphere occurs when the North Pole is pointed toward the Sun (Figure 13). This usually happens from June 20 or 21 to September 22 or 23. We experience warmer weather during this period for two reasons. First, the Sun's light more directly strikes the hemisphere that is tilted toward it, causing solar energy to be concentrated in a smaller area. Second, the hemisphere that is tilted toward the Sun receives more hours of daylight than the hemisphere that is tilted away from the Sun. So in the summer, the Northern Hemisphere receives a greater amount of solar energy for a longer period of time each day.

The winter season in the Northern Hemisphere occurs when the North Pole is pointed away from the Sun. This usually happens from December 21 or 22 to March 20 or 21. The weather is colder during this period. The Sun's light strikes at an angle the hemisphere that is tilted away from it, causing solar energy to be spread out over a larger area. Therefore, during the winter, less solar energy strikes the Northern Hemisphere. Also, the Northern Hemisphere receives solar energy for a shorter period of time each day because it receives fewer hours of daylight.

Autumn is the season between summer and winter. During autumn, the number of daylight hours decreases in the Northern Hemisphere, and the weather gets colder. Spring is the season between winter and summer. During spring, the number of daylight hours increases in the Northern Hemisphere, and the weather gets warmer. On the first day of autumn and spring, neither hemisphere is tilted toward the Sun.

READ TO UNDERSTAND

- How is Earth's axial tilt related to the seasons?
- Why is summer in the Northern Hemisphere warmer than winter?
- How are solstices and equinoxes related to the position of Earth in its orbit?

VOCABULARY

season	solstice
axial tilt	equinox
latitude	