

**Science Benchmark: 06 : 02**

Earth turns on an axis that is tilted relative to the plane of Earth’s yearly orbit. The tilt causes sunlight to fall more intensely on different parts of the Earth during various parts of the year. The differences in heating of Earth’s surface and length of daylight hours produce the seasons.

**Standard 02:**

Students will understand how Earth’s tilt on its axis changes the length of daylight and creates seasons.

*STUDENT BACKGROUND INFORMATION*

**The Mysterious Change of the Seasons**

Imagine you are a person living a long time ago, and winter is coming. The length of the day is getting shorter and the weather is getting colder. What if the days get shorter and shorter and the sun disappears entirely? Earth would be cold and dark. This is a frightening idea. The ancient Native Americans in Utah drew rock art symbols to help them know when the sun’s light would start shining longer during the winter days. This gave them comfort that the sun would once again return to warm them. The reason for the changing of the seasons was a mystery.



Other ancient people told stories to explain the seasons. One tells of how an evil person took one of the daughters of the sun as prisoner. In the sun’s anger, he withdrew more of his light each day until she was returned. This made everything cold, dark, and stormy. Finally, there was a brave person who had enough courage to save the sun’s daughter. On her return, the sun started to shine its light longer each day to bring back the warm, fair days.

Another story is told about people in the northern countries who tried to stop winter from coming. As the days became shorter, they built huge fires and performed ceremonies to convince the sun to come out for more hours each day. They found that after a few months, the sun would stay up long enough for them to plant crops and have time to grow.

Today, we know these stories are myths. This unit will help you understand why we have seasons.

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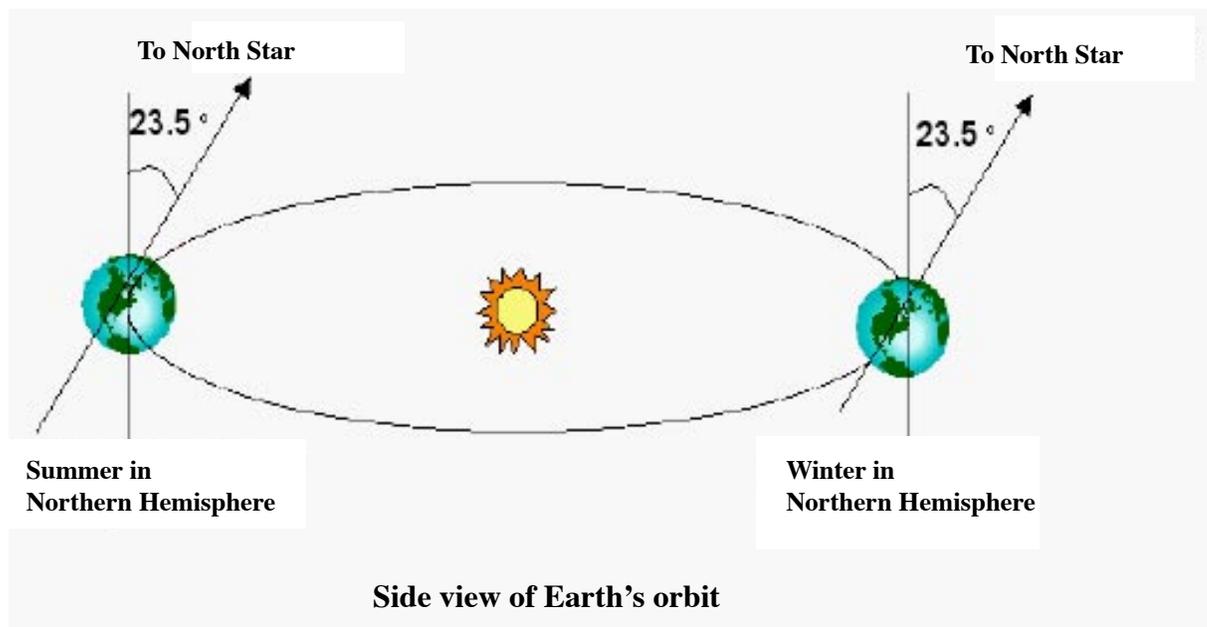
## The Seasons



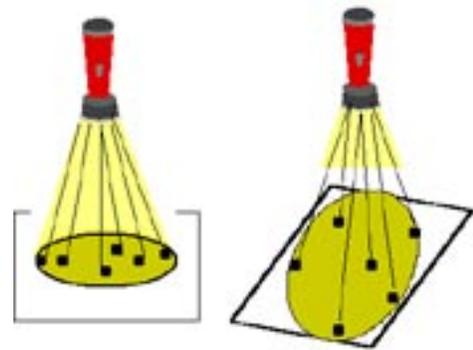
The changing of Earth's seasons depends on two important facts: (1) Earth revolves, or makes one revolution around the sun every 365 days and (2) Earth is on an angle in relation to the sun. This knowledge of Earth hasn't always been known. In 1742, an English astronomer named James Bradley was one of the first to prove Earth's repeated revolution around the sun. Bradley kept track of the position of the stars each night. He noticed many stars disappeared from the horizon and weren't seen for many months. Then they reappeared in the opposite horizon. After one year they would be back in their same positions in the sky. These observations of the changing positions of the stars showed that Earth revolves around the sun.

Earth revolves in an **orbit**, *the path a planet takes during its revolution*. The orbit of Earth around the sun is nearly circular. People incorrectly believed the seasons were caused by changes in Earth's distance from the sun during its yearly revolution. Today we know this is not the reason for the changing seasons. In fact, we are closest to the sun during our winter. The distance from the sun doesn't have much affect on the heating and cooling of Earth. So what causes the seasons each year?

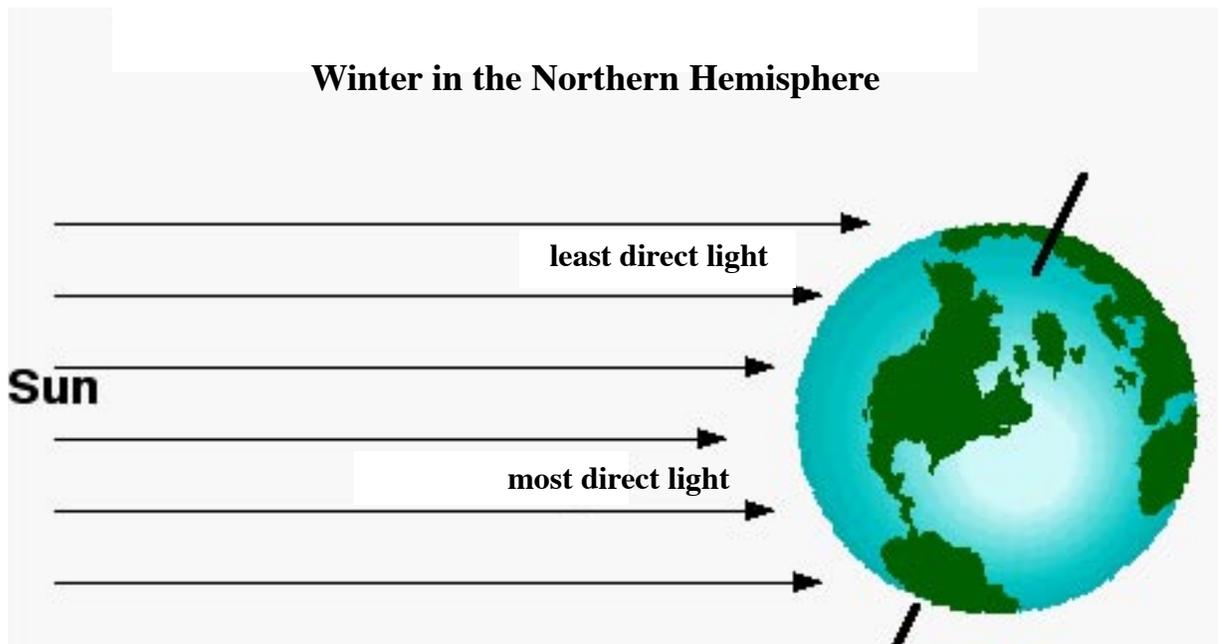
The second important fact that helps us understand Earth's seasons is **Earth's tilt**, a  $23.5^\circ$  angle. **Earth's axis of rotation**, *imaginary poles on which Earth spins*, are at a  $23.5^\circ$  angle tilt relative to the sun. As Earth revolves around the sun, it maintains this tilt, and always points in the same direction, toward the North Star. The combination of the Earth's revolution around the sun, and Earth's  $23.5^\circ$  angle tilt are the reasons we have seasons.



Why does tilt make a difference? Think of a sunburn you may have received during a day playing outdoors. Which part of you got the worst burn? Was it the top of your shoulders or your legs? Chances are, it was your shoulders. The angle of your shoulders caused them to receive the most direct rays of the sun. Your legs were angled away from the sun and absorbed less of the sun's energy. The diagram to the side shows another way to think of the sun's light and tilt. Notice that the space between the rays in diagram A is much closer than diagram B. The heat that is produced by the light in diagram A will be greater than in diagram B.

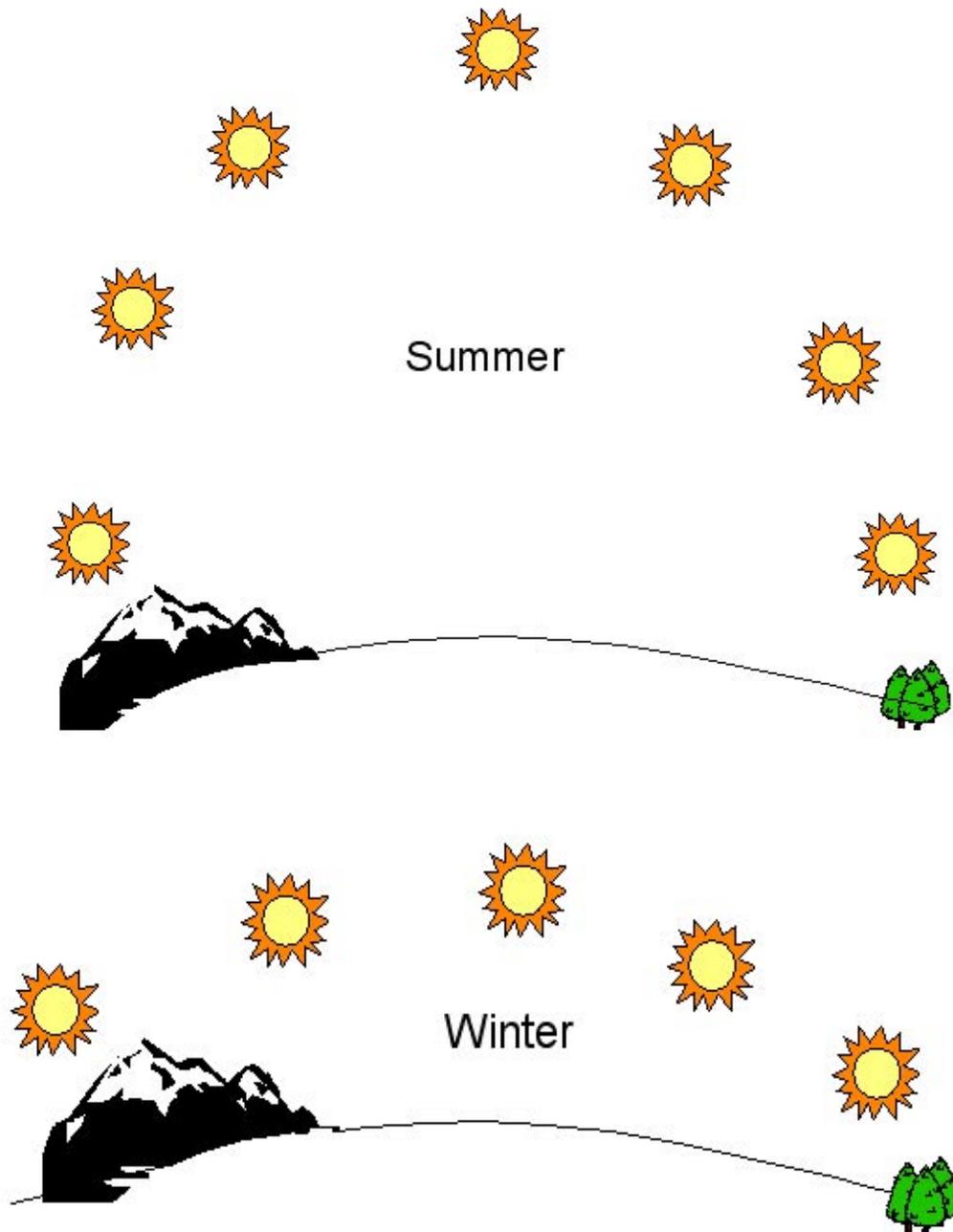


As Earth revolves around the sun, Earth's tilt never changes, yet Earth's tilt changes in relation to the sun. When Earth's North pole points away from the sun, the Northern Hemisphere has winter. When this happens, the Southern Hemisphere gets more sunlight and is warmer. People in Australia go swimming in the ocean in December because it is their summer. Six months later, Earth's North pole is pointing towards the sun and receives the most direct rays and warmth from the sun. That is when the United States has summer and the Southern Hemisphere enjoys winter.



There are two times during the year when the Northern and Southern Hemisphere have the same amount of daylight. They are March 21<sup>st</sup> and September 21<sup>st</sup>. These mark the first official days of spring and fall.

The tilt of Earth affects the height of the sun in the sky and the length of daylight. During summer, the sun stays out longer during the day and is higher overhead at noon. During the winter, the days are short because the sun never gets very high in the sky.



Think about the season you are currently enjoying. Are the days getting longer or shorter? Is the sun higher or lower in the sky each day? If you can answer these questions, you have learned a lot about seasons!

- 1. Earth's axis of rotation:** *imaginary poles on which Earth spins*
- 2. Earth's tilt:** *a 23.5° angle*
- 3. orbit:** *the path a planet takes during its revolution*