Seasons

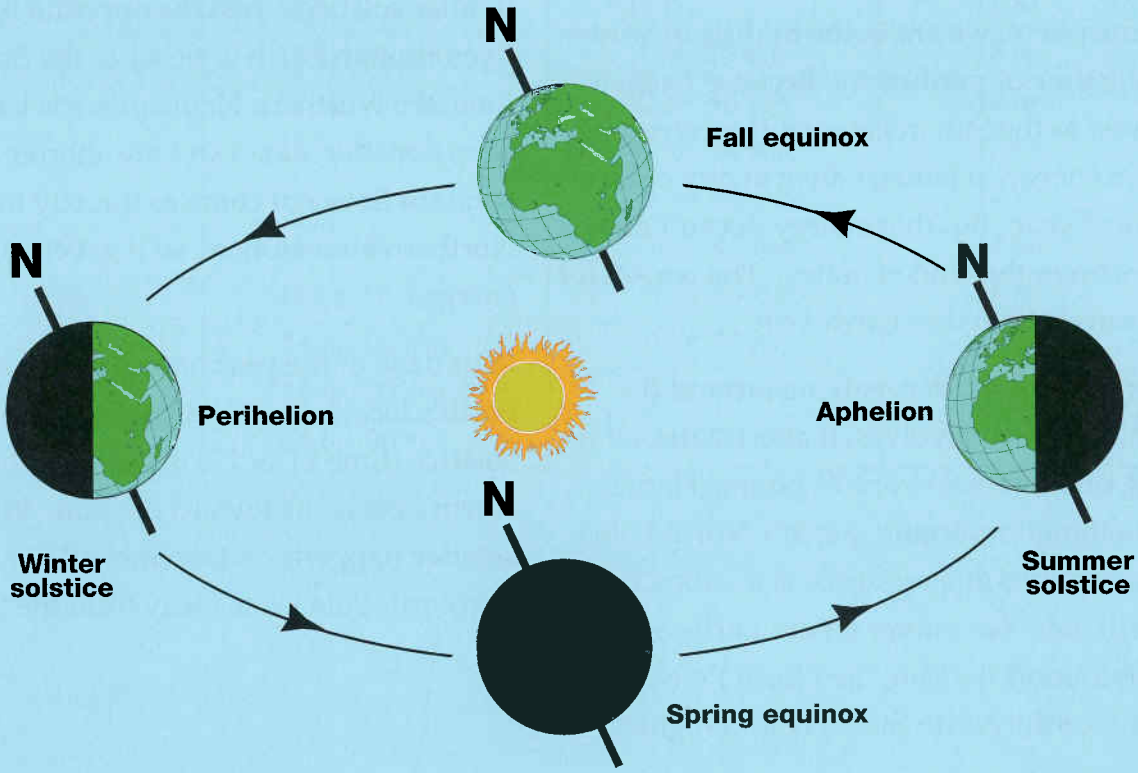
What do you picture in your mind when you read these words? Summer. Fall. Winter. Spring.

Most of us come up with a mental picture or two—summer means shorts and T-shirts, swimming, and fresh fruits and vegetables. Winter means heavy coats and short days with, perhaps, a blanket of snow on everything. Seasons are pretty easy to tell apart in most parts of the country. The amount of daylight, the average temperature, and the behavior of plants and animals are a few familiar indicators of the season. But what causes the predictable change of season? Have you ever stopped to think about why the seasons happen?

As Earth Tilts

Let's start with a quick review of some basic information about our planet.

- Earth spins on an imaginary axle called an **axis.** The axis passes through the North and South Poles. This spinning is called **rotation.** It takes 24 hours for Earth to make one rotation on its axis.
- Earth travels around the Sun. Traveling around something is called **revolution.** Earth's path around the Sun is not exactly round, but is slightly oval. One revolution takes 365 and 1/4 days, which is 1 year.



- Earth doesn't sit straight up and down on its axis as it revolves around the Sun. It is tipped at a 23.5° angle.
- The average distance between the Sun and Earth is about 150 million kilometers. Because Earth's orbit is an ellipse (oval), Earth is sometimes farther away from and sometimes closer to the Sun. **Perihelion** is when Earth and the Sun are closest to each other. Perihelion happens each year around January 3. The distance is 147 million kilometers. **Aphelion** is when Earth and the Sun are farthest apart. It happens each year around July 4. The distance is 152 million kilometers.

It would seem logical that summer would be during perihelion, when Earth is closest to the Sun. Wrong. Here in the Northern Hemisphere, we are in the middle of winter at the time of perihelion. Because Earth is closest to the Sun in January, it receives more energy in January than at any other time of year. But that energy doesn't make it warm in the United States. The reason for seasons is linked to Earth's tilt.

Think about Earth revolving around the Sun. As Earth revolves, it also rotates on its axis, one rotation every 24 hours. Here's something important: Earth's North Pole *always* points at a reference star called the North Star. No matter where Earth is in its orbit around the Sun, the North Pole always points at the North Star, day and night.

Tilt Equals Season

Look at the illustration on page 17. It shows where Earth is in its orbit around the Sun at each season. You will also see that the North Pole points toward the North Star in all four seasons.

Study the Earth image in the summer solstice position. Because of the tilt, Earth is "leaning" toward the Sun. When the North Pole is leaning toward the Sun, it is summer in the Northern Hemisphere. Days are longer, and the angle at which light hits that part of Earth is more direct. Both of these factors result in more solar energy falling on the Northern Hemisphere in summer (thus more heat) even though the planet is actually farther away from the Sun.

Look at the position of Earth 6 months later (winter solstice). Just the opposite is true. Even though Earth is closer to the Sun at this time, the Northern Hemisphere is leaning *away from* the Sun. Days are shorter, and sunlight does not come as directly to the Northern Hemisphere, so it gets less solar energy.

Four days in the year have names based on Earth's location around the Sun. **Summer solstice** (June 21 or 22) is the day when the North Pole leans toward the Sun. **Winter solstice** happens on December 21 or 22 when the North Pole leans away from the Sun.

The 2 days when the Sun's rays shine straight down on the equator are the **equinoxes.** Earth's axis is tilted neither away from nor toward the Sun. *Equinox* means "equal night." Daylight and darkness are equal (or nearly equal) all over Earth. There are two equinoxes each year, **spring equinox** (March) and **fall equinox** (September).

Daily Dose of Sunshine

We take night and day for granted. They always happen. The Sun comes up; the Sun goes down. This cycle has happened as long as humans have been on Earth. It will most likely continue for millions of years.

Because Earth tilts, the length of day and night changes as the year passes. This table shows how hours of daylight change by latitude during the year. When it's summer in the Northern Hemisphere, the North Pole leans toward the Sun. At the North Pole, the Sun never sets. Above the Arctic Circle (66.5° north), daylight can last all 24 hours of the day.

LENGTH OF DAYLIGHT IN THE NORTHERN HEMISPHERE

Latitude (°N)	Summer solstice	Winter solstice	Equinoxes
0	12 hr.	12 hr.	12 hr.
10	12 hr. 35 min.	11 hr. 25 min.	12 hr.
20	13 hr. 12 min.	10 hr. 48 min.	12 hr.
30	13 hr. 56 min.	10 hr. 04 min.	12 hr.
40	14 hr. 52 min.	9 hr. 08 min.	12 hr.
50	16 hr. 18 min.	7 hr. 42 min.	12 hr.
60	18 hr. 27 min.	5 hr. 33 min.	12 hr.
70	24 hr. 00 min.	0 hr. 00 min.	12 hr.
80	24 hr. 00 min.	0 hr. 00 min.	12 hr.
90	24 hr. 00 min.	0 hr. 00 min.	12 hr.