Seasons on Earth

What do you imagine when you read these words: summer, spring, fall, winter?

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, perhaps with a blanket of snow on everything. **Seasons** are pretty easy to tell apart in most parts of the United States. The amount of daylight, the average temperature, and the behaviors of plants and animals are a few familiar indicators of the season. But what causes the predictable change of season? What have you learned in class that helps you explain the reasons for the seasons?

As Earth Tilts

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

Earth spins on an imaginary axle called an **axis**. The axis passes through the North and South Poles. This spinning on an axis is called **rotation**. It takes 24 hours for Earth to make one complete rotation.

Earth travels around (**orbits**) the Sun. Traveling around something is called **revolution**. Earth's path around the Sun is not exactly round. It is slightly oval. One revolution takes 365 and 1/4 days, which we call 1 year.

Make a notebook entry. Record the reasons for seasons on Earth. You can add more after reading this article, but record your first ideas now.

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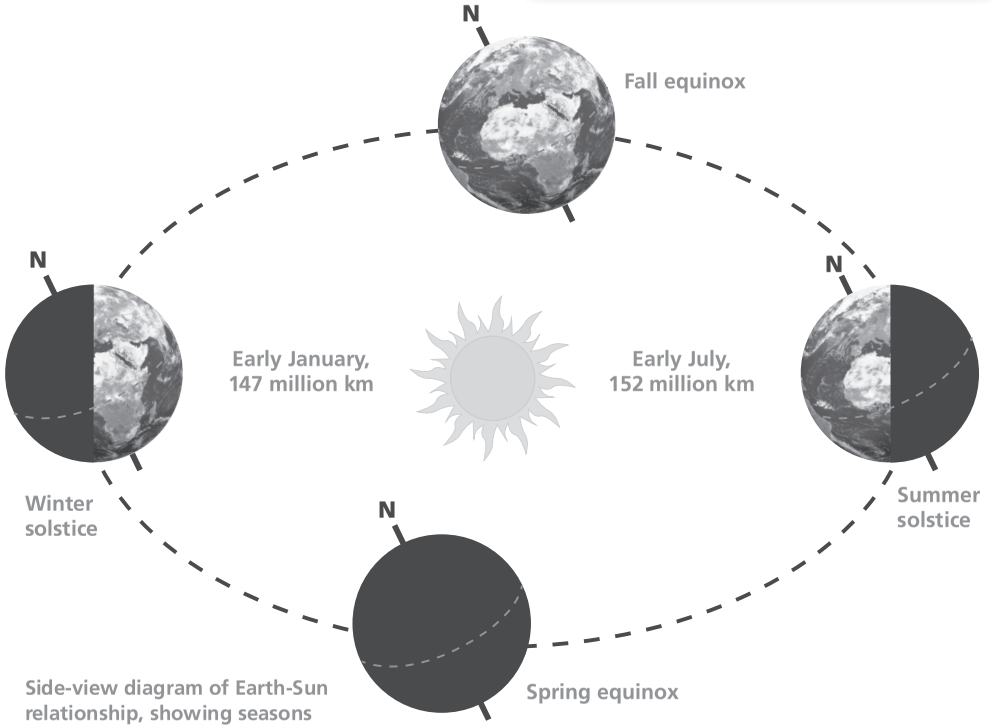
Earth isn't straight up and down on its axis as it revolves around the Sun. It is tilted at a 23.5° angle.

The average distance between the Sun and Earth is about 150 million kilometers (km). Earth's orbit is slightly oval, so Earth is sometimes farther away from and sometimes closer to the Sun. This distance is so insignificant that it is not related to the seasons.

It would seem logical that summer would be when Earth is closest to the Sun. That idea is wrong. Each year when Earth is closest to the Sun, the Northern Hemisphere experiences winter. The reasons for the seasons are linked to Earth's tilt, not the distance from the Sun.

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 points toward a reference **star** called the **North Star**. No matter where Earth is in its orbit around the Sun, the North Pole points toward the North Star, day and night, every day all year.

Is Earth closer to the Sun in winter or in summer? Is distance from the Sun a reason for seasons on Earth?



Side-view diagram of Earth-Sun relationship, showing seasons in the Northern Hemisphere. (Not drawn to scale.)

North Star

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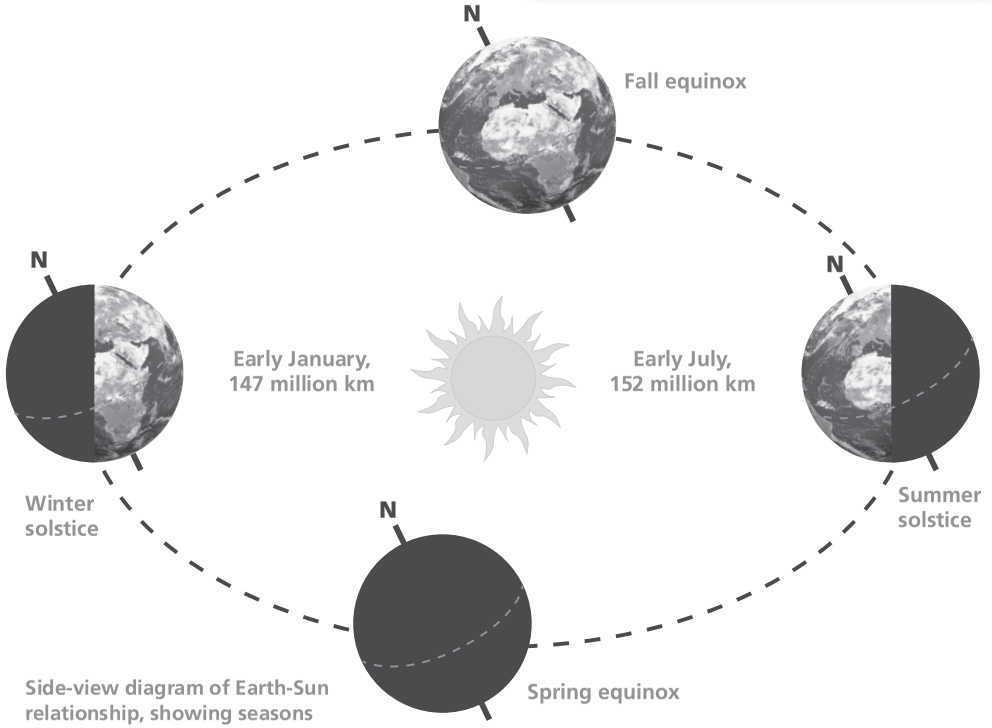

Side-view diagram of Earth-Sun relationship, showing seasons in the Northern Hemisphere. (Not drawn to scale.)

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Tilt Equals Season

Look at the illustration on page 11. 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 diagram in the summer **solstice** position. Because of the tilt, the North Pole is "leaning" toward the Sun. When the North Pole is leaning toward the Sun, daylight is 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. It is summer even though Earth is actually farther from the Sun. (And when it is summer in the Northern Hemisphere, it is winter in the Southern Hemisphere.)

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

Four days in the year have names based on Earth's location around the Sun. In the Northern Hemisphere, summer solstice is June 21 or 22, when the North Pole tilts toward the Sun. Winter solstice is December 21 or 22, when the North Pole tilts away from the Sun.

The 2 days when the Sun's rays shine straight down on the equator are the **equinoxes**. On these 2 days, 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, the spring (also called vernal) equinox in March and the fall (also called autumnal) equinox in September.

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Day and Night

We take day and night for granted. They always happen. Earth rotates on its axis, and the Sun appears to rise; then the Sun appears to set. This cycle has happened at least as long as humans have been on Earth. It will most likely continue for millions of years.

Because Earth is tilted, the length of day and night for any one place on Earth changes as the year passes. This table shows how hours of daylight change at different latitudes during the year. When it's summer in the Northern Hemisphere, the North Pole tilts toward the Sun. During this time at the North Pole, the Sun never sets. Above the Arctic Circle (66.5° north), daylight can last up to 24 hours of the day in the summer. Darkness can last up to 24 hours of the day during the winter.

Think Questions

Go back to your notebook entry about the reasons for the seasons that you made at the beginning of this article. What do you need to add? What do you need to change?

Length of Daylight in the Northern Hemisphere

Latitude	Summer solstice	Winter solstice	Equinoxes
0° N	12 hr.	12 hr.	12 hr.
10° N	12 hr. 35 min.	11 hr. 25 min.	12 hr.
20° N	13 hr. 12 min.	10 hr. 48 min.	12 hr.
30° N	13 hr. 56 min.	10 hr. 4 min.	12 hr.
40° N	14 hr. 52 min.	9 hr. 8 min.	12 hr.
50° N	16 hr. 18 min.	7 hr. 42 min.	12 hr.
60° N	18 hr. 27 min.	5 hr. 33 min.	12 hr.
70° N	24 hr.	0 hr.	12 hr.
80° N	24 hr.	0 hr.	12 hr.
90° N	24 hr.	0 hr.	12 hr.

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70° N	24 hr.	0 hr.	12 hr.
80° N	24 hr.	0 hr.	12 hr.
90° N	24 hr.	0 hr.	12 hr.

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