

Getting to Know: Rotation, Orbits, and the Seasons

You can observe rotation nearly everywhere in the universe. On Earth, many amusement park rides rotate around a central point called an *axis of rotation*. A merry-go-round is an example. The seats of the ride rotate around this central axis turned by a motor. In the solar system, each planet rotates naturally around an invisible axis.

Each planet has a unique rotation rate. Earth rotates once on its axis every 24 hours. Within that period, Earth completes a full cycle of night and day. Mercury rotates once on its axis every 59 days. Jupiter spins much faster, turning once on its axis approximately every 10 hours.



A merry-go-round rotates around a central axis, similar to the planets.



Misconception 1: *Do all objects in the solar system rotate in the same direction?*

If viewed from above, most objects in the solar system rotate counterclockwise. Earth rotates toward the east, which is why the Sun “sets” in the west. Interestingly, Venus rotates in the opposite direction of Earth, and Uranus is turned on its side so its rotation is at approximately a 90° angle to that of Earth. A few moons and other small bodies in our solar system also turn clockwise.

Is rotation different from an orbit?

Rotation involves one object in space. Orbits involve two or more objects. An *orbit* is the revolution of one astronomical body around another astronomical body. Earth orbits the Sun and the moon orbits Earth. Each of the planets in our solar system orbits the Sun.

It takes Earth 365¼ days to complete one orbit around the Sun. The length of time that it takes each planet to complete an orbit is related to the planet’s distance from the Sun. The farther a planet is away from the Sun, the longer it takes to complete one orbit. For instance, the planet Neptune, the eighth planet from the Sun, takes almost 165 years to make one complete trip around the Sun. The planet Mercury completes one orbit in just 88 days.

How long does it take our moon to complete an orbit of Earth?

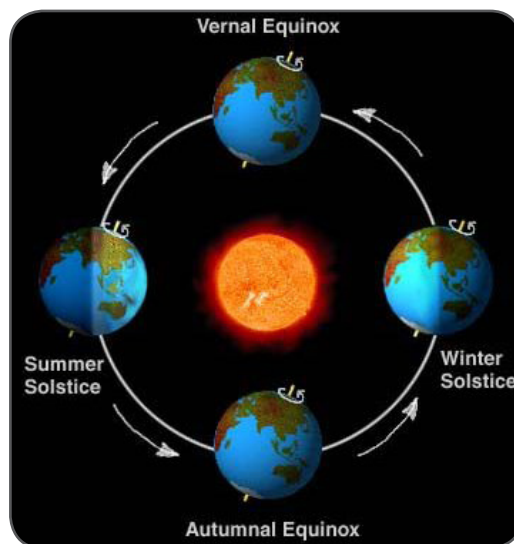
The moon completes one orbit of Earth approximately every 27 days (27.3, to be more precise). If you look at the moon with binoculars, you probably noticed that you see the same side of the moon every day. Only one side of the moon ever faces the Earth. That is because the moon rotates on its axis approximately every 27 days and completes an orbit in the same timeframe.

Why does Earth experience seasons?

Seasons are caused by the fact that Earth is tilted on its axis. Earth's axial tilt is approximately 23.5° from perpendicular. As Earth orbits the Sun, parts of Earth that are tilted toward the Sun receive more direct solar radiation. For example, it is summer in the Northern Hemisphere when the Northern Hemisphere leans toward the Sun. When the Northern Hemisphere leans away from the Sun, it is winter. In fact, the North Pole is tipped away so much that the Sun is not seen in winter and it doesn't set in summer. In the Southern Hemisphere, the seasons are opposite those of the Northern Hemisphere.

During winter, the days are shorter and the Sun's rays do not shine as directly on the area of Earth experiencing winter. You may notice that the Sun does not rise as high in the sky during winter. The *angle of incidence* is the angle that the Sun's rays strike Earth's surface. This angle is greater in the winter and smaller in the summer. That means that the heat energy radiated by the Sun is spread over a larger area, resulting in cooler temperatures. This is why there is little seasonal variation at locations near the equator. The Sun shines more directly onto equatorial regions throughout the year.

Keep exploring this concept to learn more about the seasons and how Earth's rotation and orbit affect life on Earth!



Winter in the Northern Hemisphere occurs when that half of Earth is tilted away from the Sun. (Image from NASA)



Misconception 2: Is Earth closer to the Sun in the summer?

The seasons are not caused by the fact that the distance from Earth to the Sun varies. All of the planets in the solar system have orbits that are not perfectly circular. That means there are times when the Earth is slightly closer to the Sun. However, distance to the Sun does not significantly affect seasonal variations. In fact, Earth is closest to the Sun during the Northern Hemisphere's winter.