

Sun-Earth Connection Key Terms

Aphelion is the point in a planet's elliptical orbit at which it is farthest from its star.

Arctic Circle (66.5°N) and **Antarctic Circle** (66.5°S) are the latitudes that have one day of 24 hour daylight and darkness. Poleward of these latitudes, there are more periods of daylight/darkness exceeding 24 hours. The North and South Poles each have 6 months of continuous daylight followed by 6 months of continuous darkness. Is it coincidence that these latitudes are equal to $\pm(90^\circ - \text{Earth's obliquity})$?

Astronomical Unit (AU) is a unit of length equal to the mean distance from the center of the Sun to the center of the Earth (149.6 million kilometers or 93 million miles).

Beam spread (the ratio of the size of illuminated horizontal surface to the size of a beam of sunlight creating the illumination) and **peak solar energy** depend on the angle of the sun above the horizon. If the Sun is in the horizon, the rays actually don't hit the ground (they are parallel to it), so the beam is spread out over an infinite piece of real estate. When the Sun is directly overhead or at zenith, then the size of the beam is the same size illuminating the ground, so the beam spread is 1.

Solar **declination** is the angle between the rays of the **Sun** and the plane of the Earth's Equator.

Eccentricity is the deviation of Earth's orbit from circularity. The greater the eccentricity, the greater the elliptical nature of the orbit. Earth's eccentricity is nearly circular with an eccentricity of 0.0167, so the short axis is 99.986% of the long axis.

Equinoxes occur when Earth's axis of rotation is neither toward or away from the Sun, causing equal illumination of the Northern and Southern Hemispheres that day.

Horizon is the flat piece of real estate that surrounds your location.

Latitude is defined by the Earth's axis of rotation (or any rotating object). The North and South Poles are the intersection of the axis with the Earth's surface, and have latitudes of 90°N and 90°S, respectively. The Equator, halfway between the Poles, has a latitude of 0°.

Another way to consider latitude, is that it represents the distance from the axis of rotation, with 90° being on the axis of rotation, and 0° furthest from the axis of rotation.

Look along a latitude and you are oriented East or West since the latitude circle is perpendicular to the axis of rotation, which defines North and South.

Latitude Circle connects all points of the same latitude. It also shows the path of a person as they rotate around the axis of rotation for a day.

Local noon occurs when the Sun is highest in the sky and defines a solar day. We have defined this as taking 24 hours. Because the Earth's orbit is not perfectly circular, the length between time between local noon changes just a bit throughout the year, so 24 hours is actually defined by averaging the time between local noon through the year.

Longitude is the angular measurement from the Prime Meridian (the longitude going through the Royal Observatory, Greenwich, England, and defined as 0°). Its range extends $+180^\circ$ eastward to -180° westward.

Another way to consider longitude is it helps us define time since every point on a longitude experiences local noon at the same clock time.

Obliquity is the angle between the planes of the Earth's equator and its orbit around the Sun. Another way to think about it is the angle of the Earth's axis of rotation from the perpendicular to the plane of orbit. Earth's obliquity is 23.5° .

Perihelion is the point in a planet's elliptical orbit at which it is closest to its star.

Precession is the gradual change in the orientation of the rotational axis of a rotating body. Think of the wobbling axis of a spinning top.

Solstices occur when Earth's axis of rotation is pointing most toward the Sun, causing either the Northern or Southern Hemisphere to be most illuminated that day.

Time: Sun Time is different from **Clock Time**.

Sun Time is set by when the Sun is highest in the sky (Local Noon). All points on a latitude experiences the same timing of sunrise, local noon, and sunset.

Clock time depends on time zone (a 15° band of longitude) you are in relative to the Prime Meridian. Everyone has the same clock time the band of longitude, so sunrise, local noon have different clock times depending on where you are in the time zone.

Tropic of Cancer (23.5°N) and **Tropic of Capricorn** (23.5°S) are the latitudes where the Sun is directly overhead at local noon once a year. Between these latitudes, the Sun is overhead twice a year. Poleward of these latitudes the Sun is never directly overhead. Interesting that these latitudes are equal to the \pm values of Earth's obliquity.

Zenith is point directly overhead of your location.