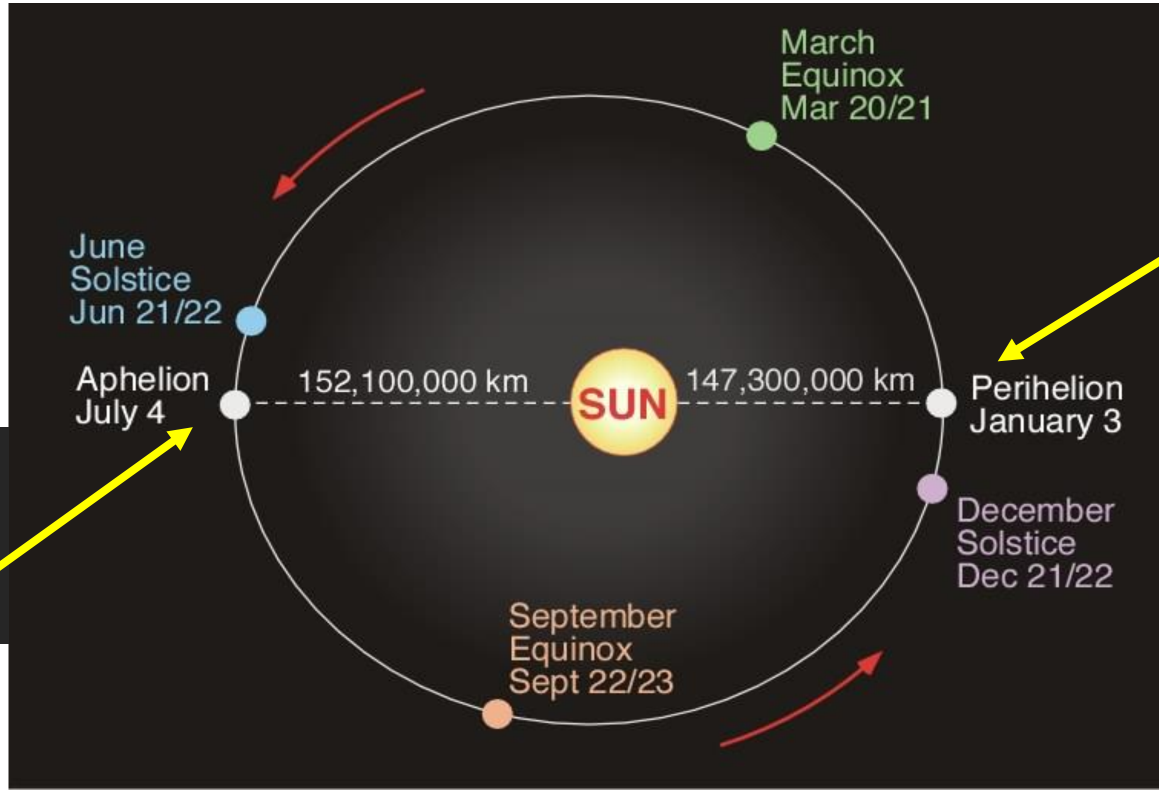
Earth Orbit

Farthest away from the Sun



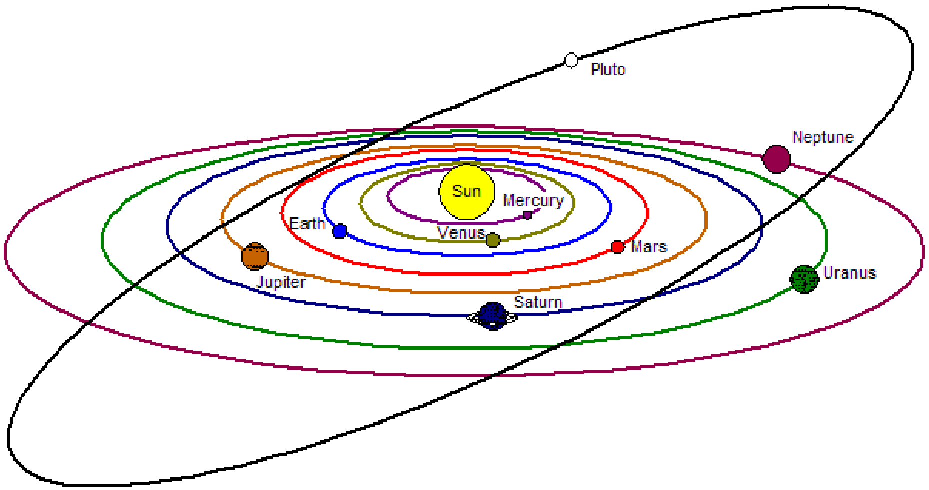
Closest approach to the Sun

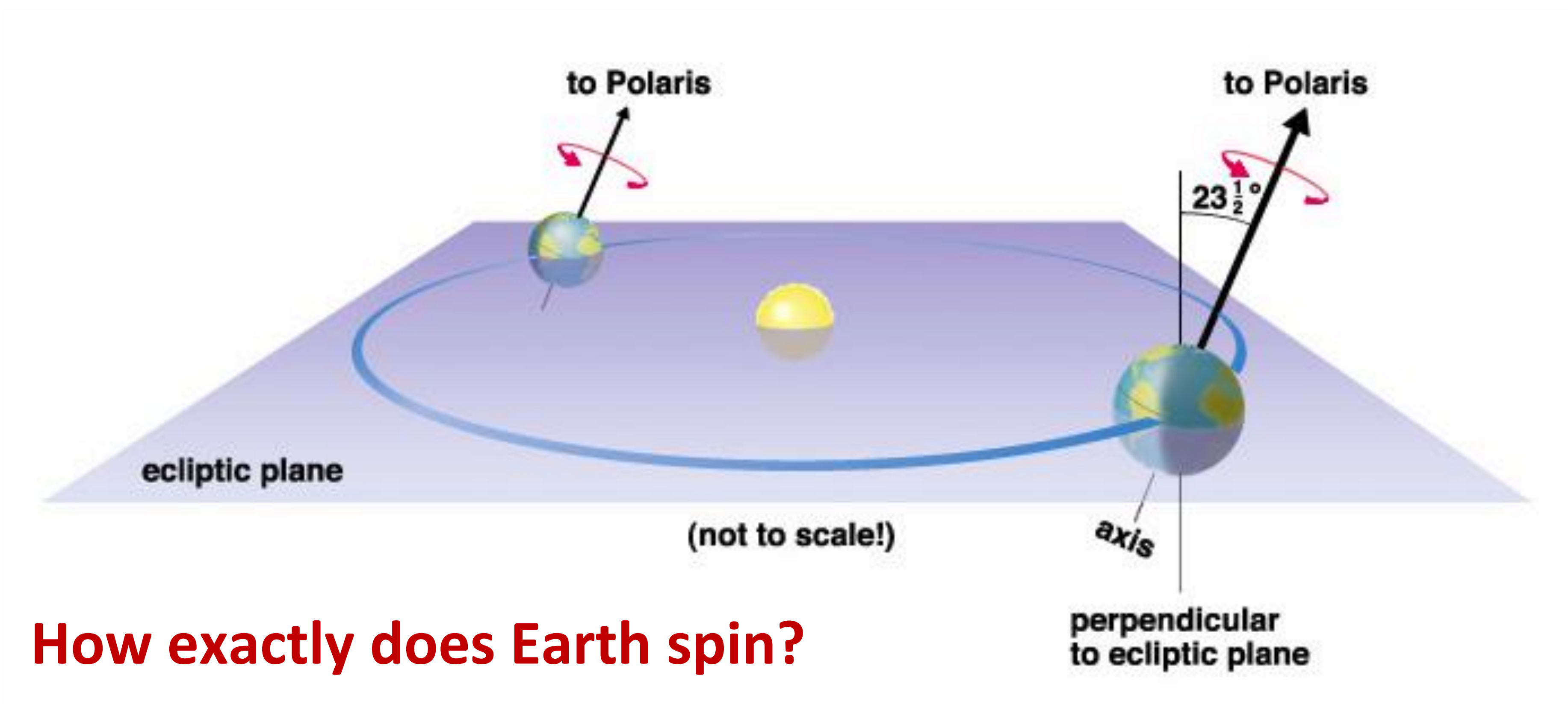
THAT WAS JUST 5 DAYS AGO!

- The **orbit** of the Earth is ***almost* a perfect circle**: our mean distance to the Sun is about **150 million km** (~93 million mi).
- The **orbital speed** of the Earth (how fast it travels along its orbit around the Sun) is about **30 km/s** (~67,000 mph).

Ecliptic Plane

Imaginary plane containing the Earth's orbit around the Sun.

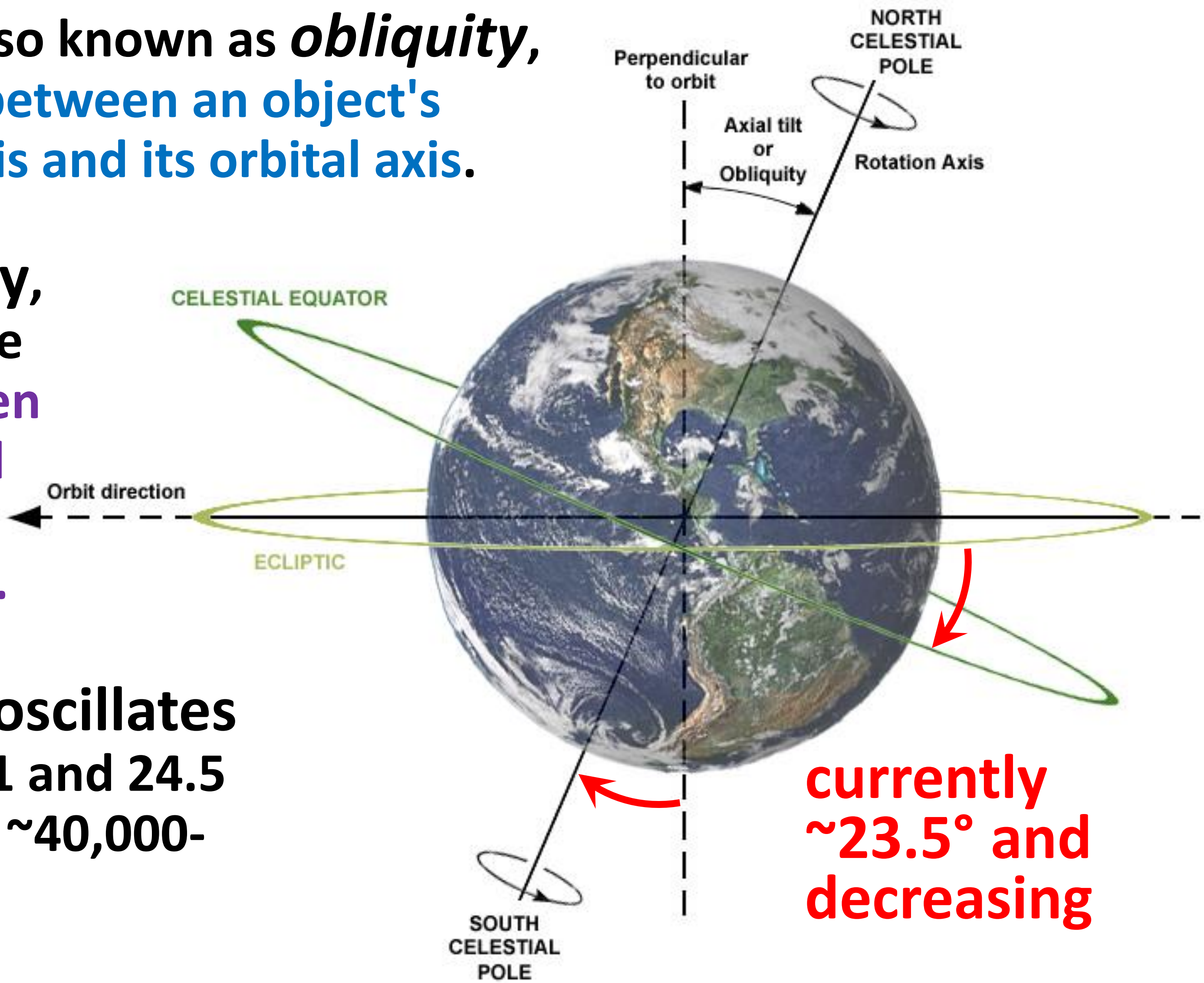




How exactly does Earth spin?

Earth Spin Axis Is Tilted!

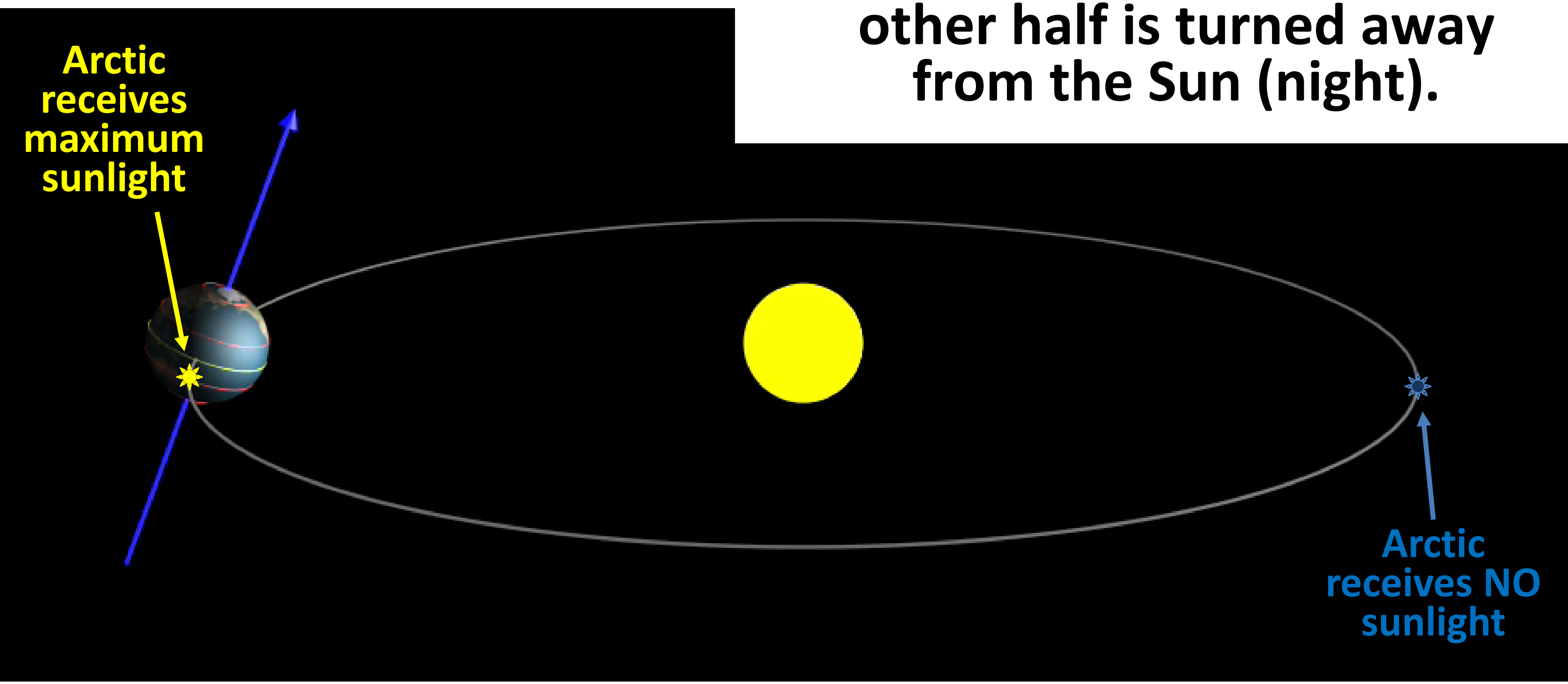
- <u>**Axial tilt**</u>**, also known as *obliquity*, is the angle between an object's rotational axis and its orbital axis.**
- **Equivalently, axial tilt is the angle between its equatorial plane and orbital plane.**
- **Earth's tilt oscillates between 22.1 and 24.5 degrees on a ~40,000-year cycle.**



currently ~23.5° and decreasing

Day and Night

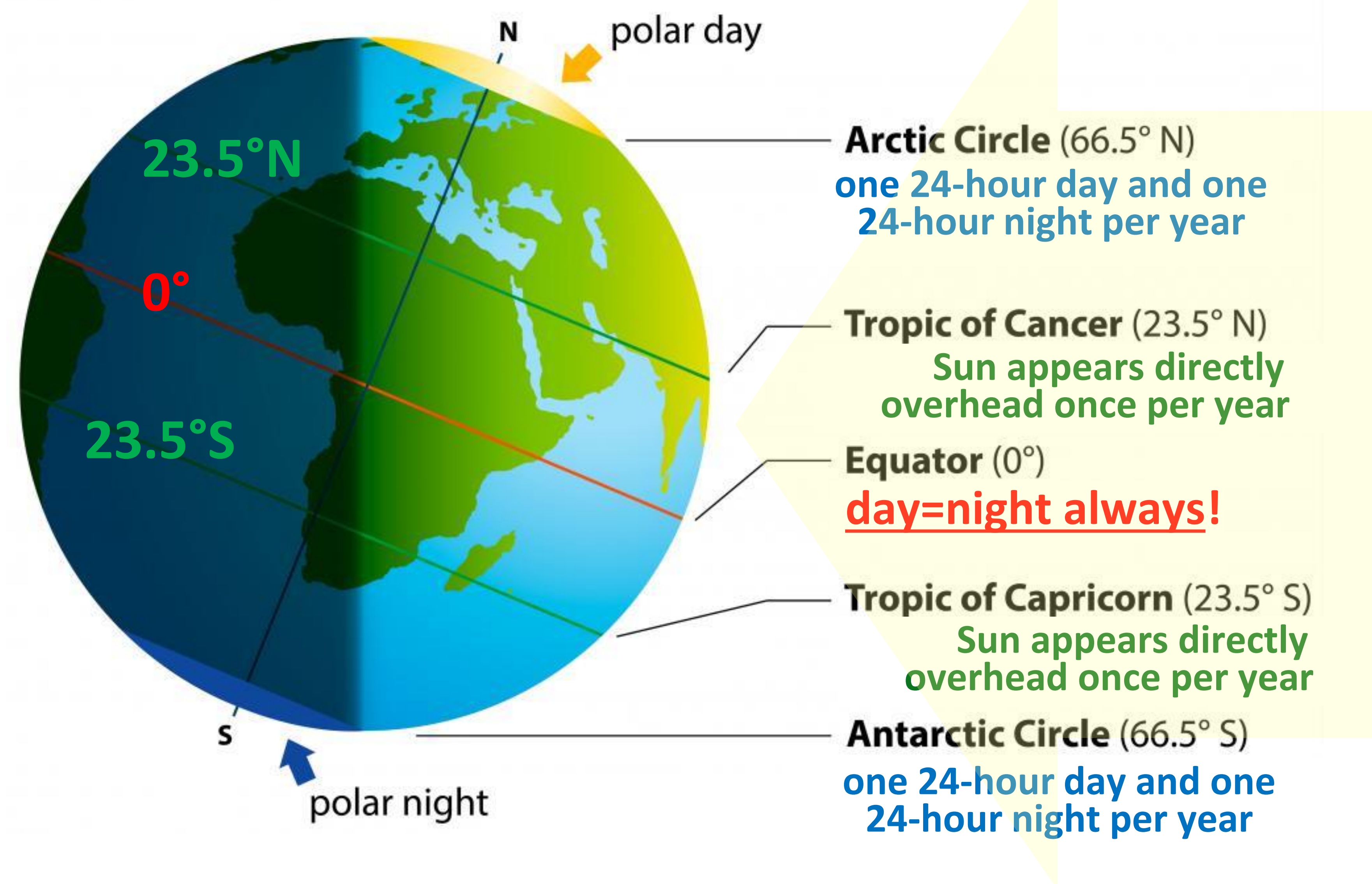
- Every moment of time half of the planet is exposed to sunlight (day) while the other half is turned away from the Sun (night).



- The circle of illumination *(an imaginary line that separates light from darkness and day from night)* changes its position on the Earth’s surface as the planet moves along its orbit.

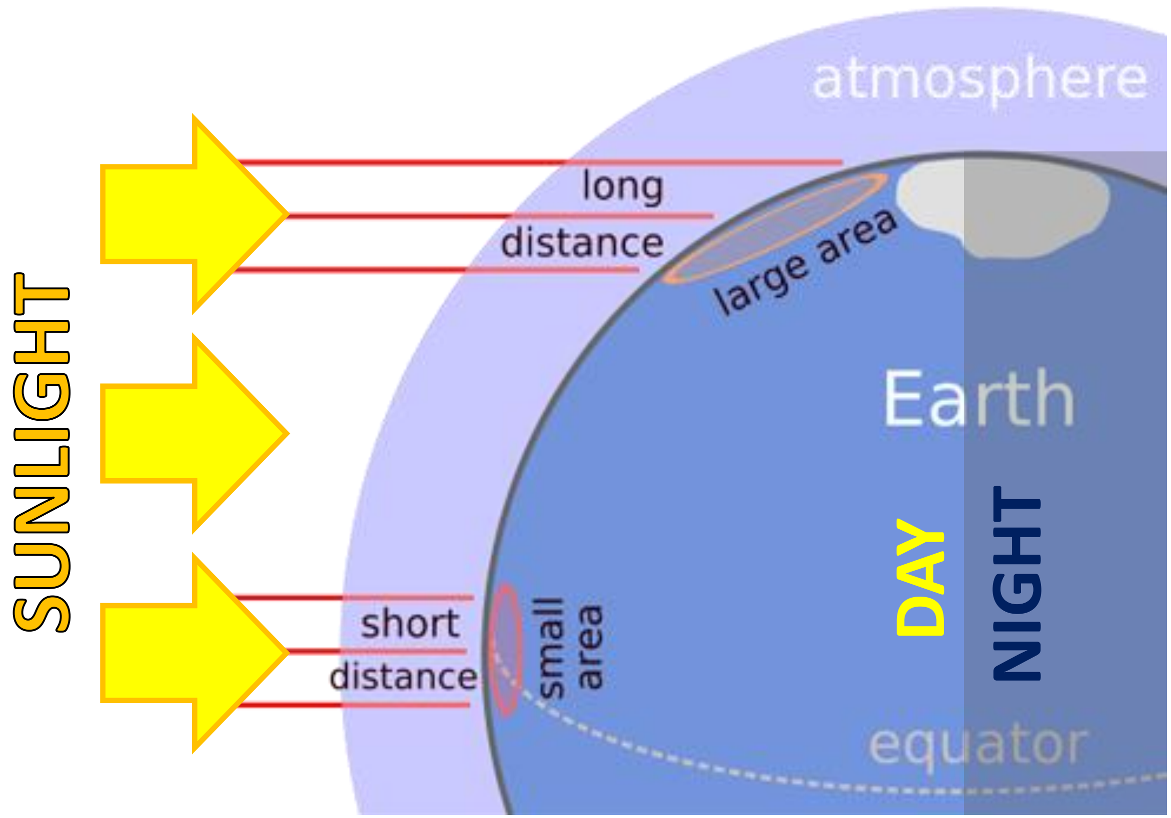
Special lines on the Earth's surface

Due to the Earth's tilt day-to-night ratio varies over latitude.



Angle of Sunlight

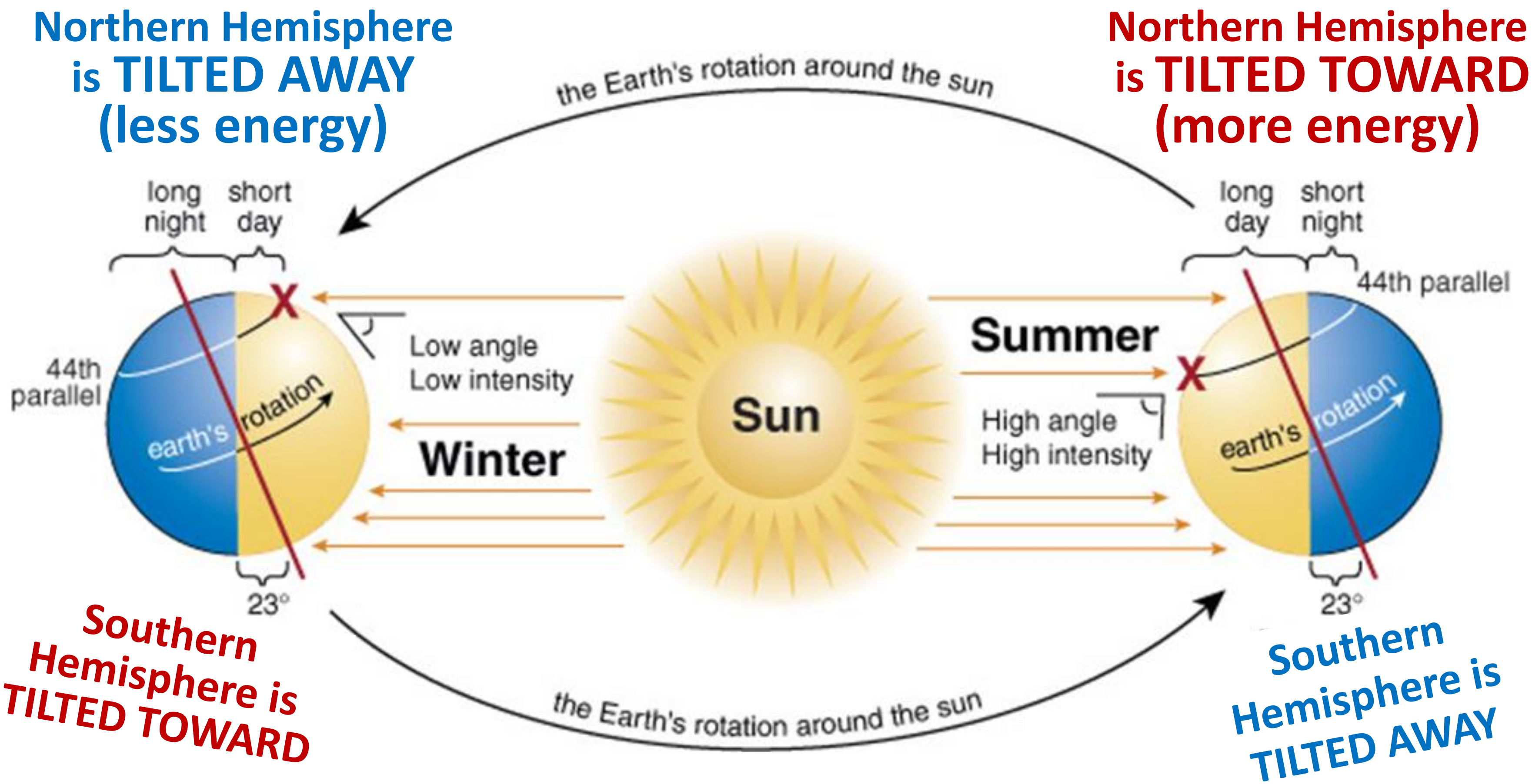
Due to the Earth's curvature, the amount of sunlight (*energy*) reaching any given point on the surface varies greatly with latitude.



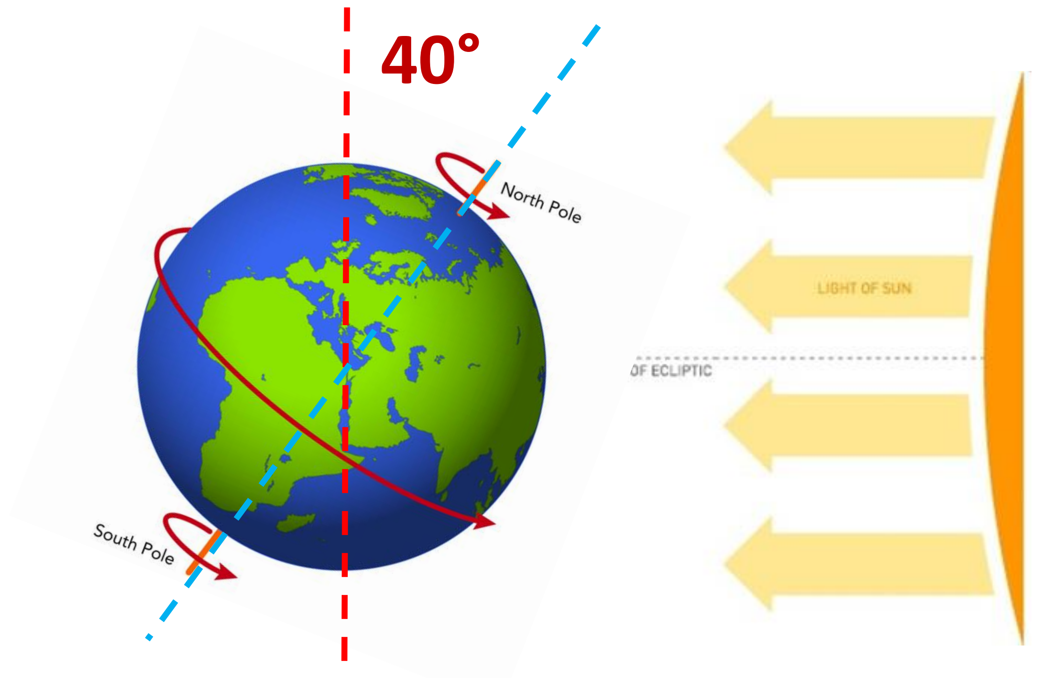
- **Regions near the Equator receive most direct, that is concentrated Sun rays.**
- **At high latitudes, the same amount of the incoming Sun energy is spread over much greater area of surface.**

The available amount of energy defines how much warmed up a certain area can get during the daytime… does it change?

Due to the Earth's tilt with respect to its orbital plane, the amount of sunlight *energy* reaching any given point on the surface varies over the course of the year, giving us SEASONS.



Exercise: if Earth was tilted at 40 degrees instead of 23.5 degrees, would winters in New York be warmer or colder?



Colder! And <u>summers would be hotter</u> since the larger tilt would mean that the hemispheres would be tilted more away or more towards the Sun. However, the equator would still be the same average temperature!

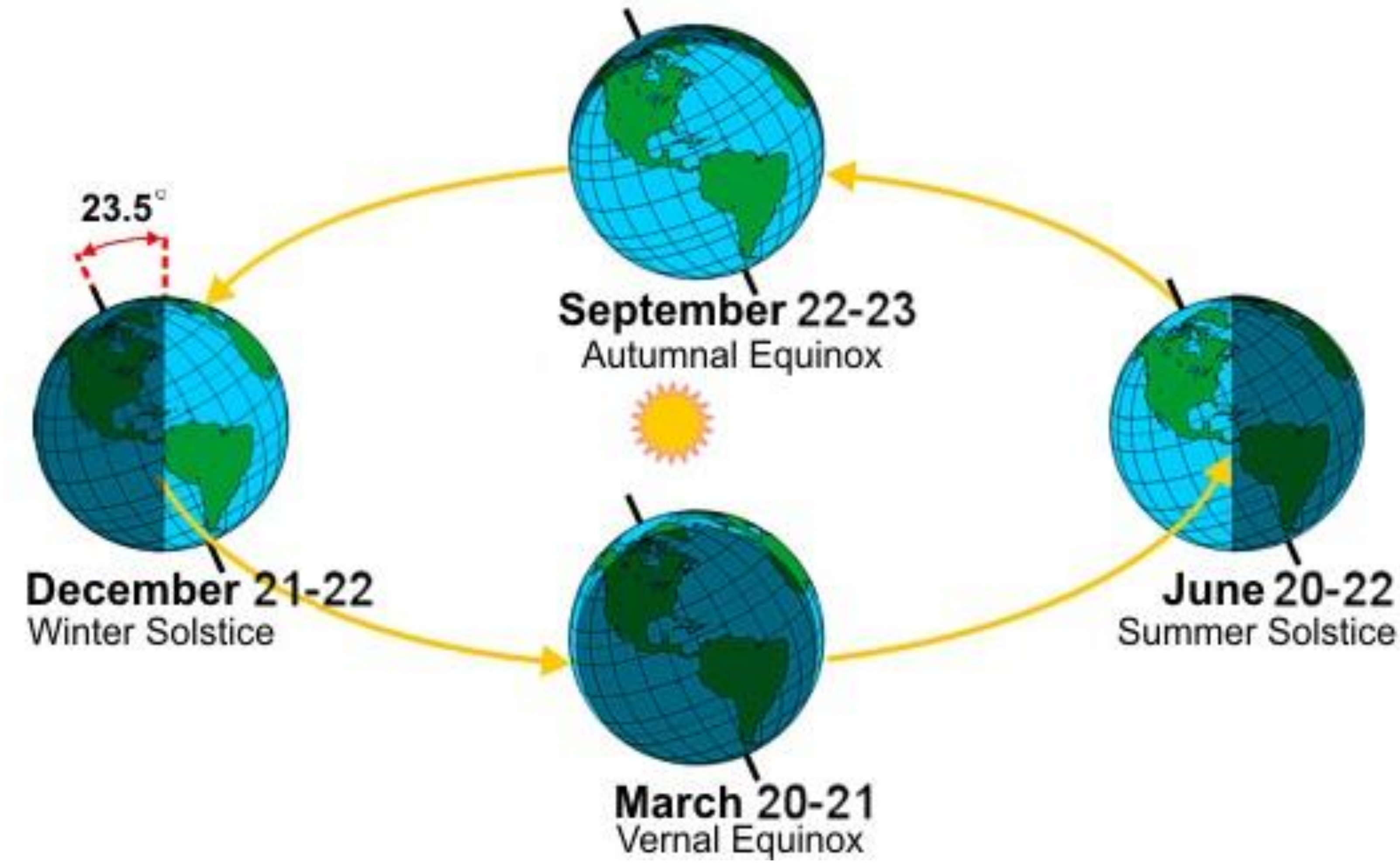
Seasons in the Southern Hemisphere are opposite to those in the Northern Hemisphere.

On the 1st day of Winter, daylight length in Fairbanks, Alaska is just 3 hr 41 min 48 sec!

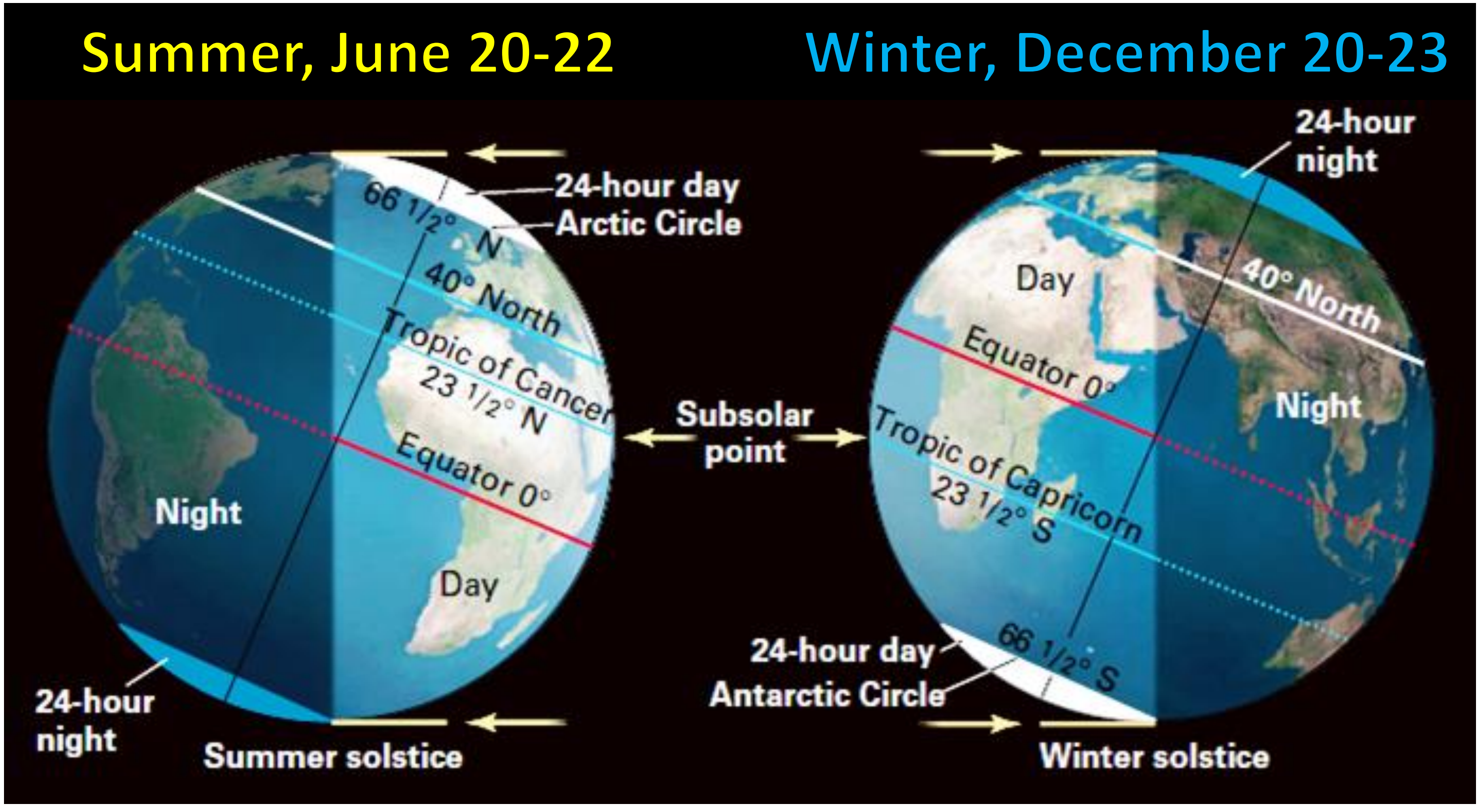
At the same time, on the 1st day of Summer, the Sun in Antarctica dips to the horizon but doesn't set!

Change of Seasons

Astronomers use special dates of the year - equinoxes and solstices - to mark the change of seasons.

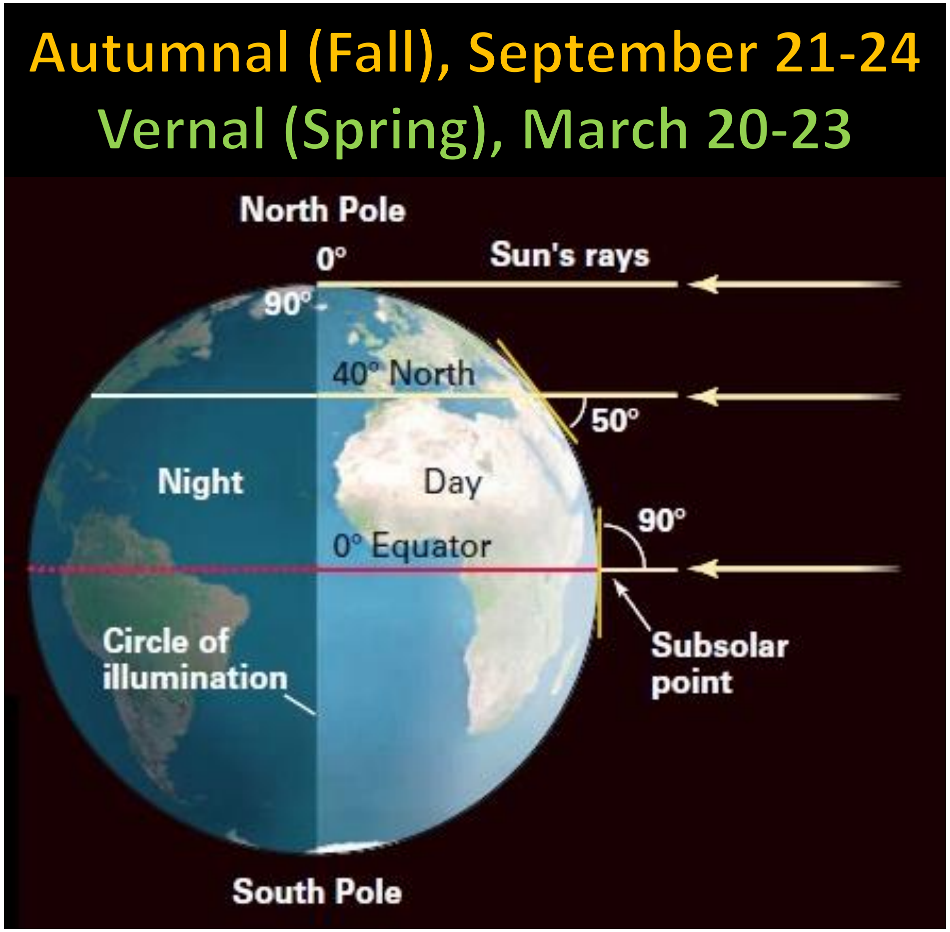


Solstice conditions (Northern Hemisphere)



- **At solstice *(Latin: "sun"+"stand still")*, the Earth's axis of rotation is fully tilted either toward or away from the Sun.**
- **Polar regions experience either 24-hour day or 24-hour night.**
- **<u>The Sun is directly overhead at noon on one of the tropics</u>.**

Equinox conditions



- At equinox *(Latin: "equal"+"night")*, the Earth's axis of rotation is exactly at right angle to the direction of solar illumination.
- The circle of illumination passes through the North and South Poles.
- At noon, the Sun is directly overhead on the Equator.
- Both hemispheres are equally illuminated.
- At both poles the Sun is seen at the horizon.