

What do we see from Earth?

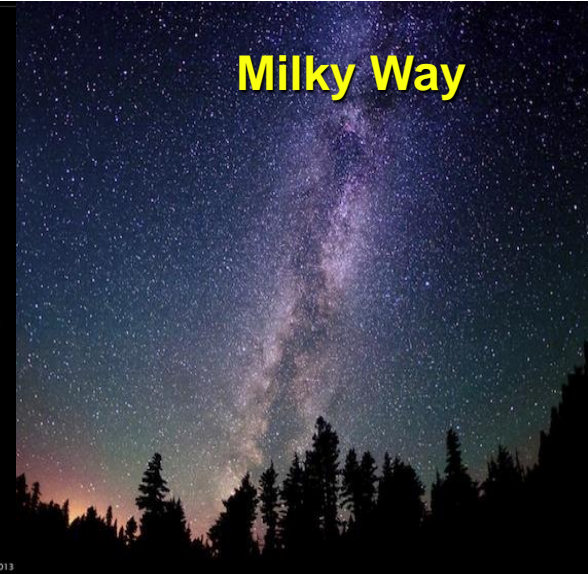
Sun



Moon



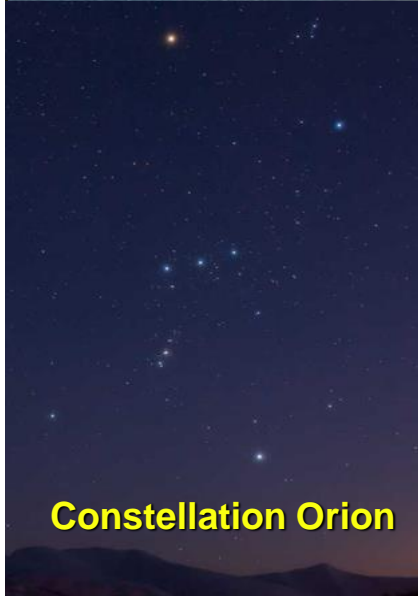
Milky Way



Meteors



Constellation Orion

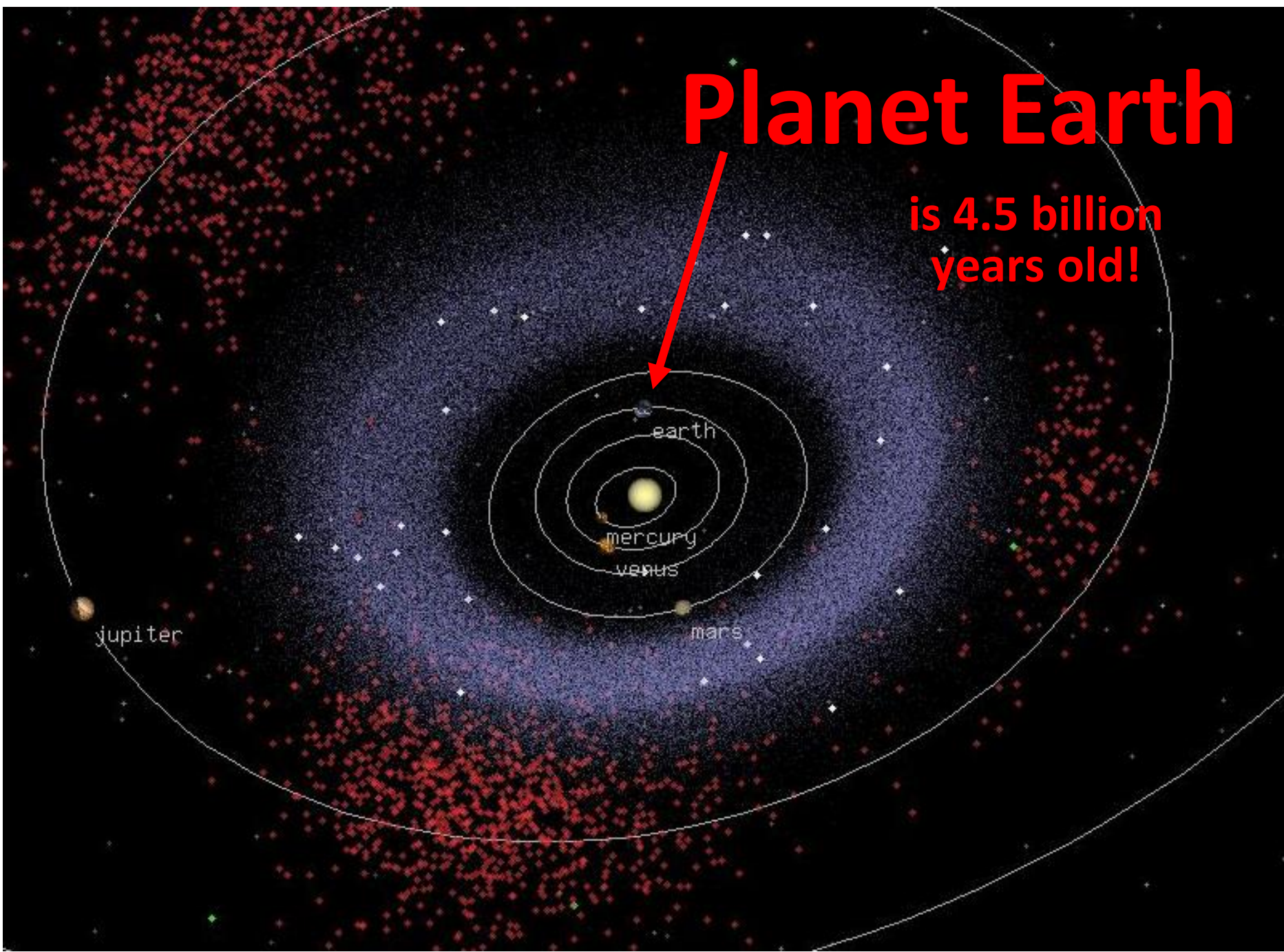


Mars



Planet Earth

is 4.5 billion
years old!



jupiter

mars

mercury

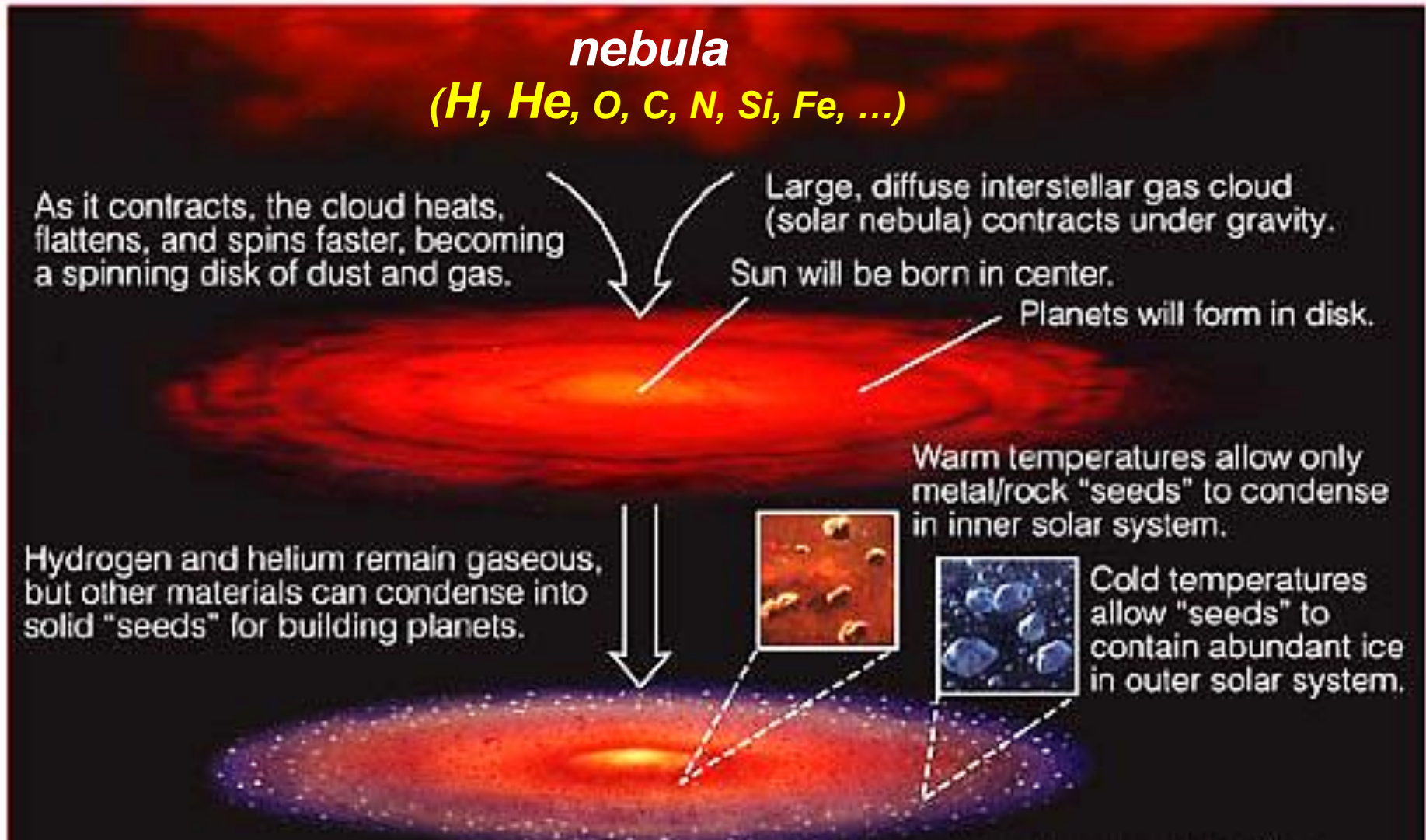
venus

earth

The Formation of the Solar System

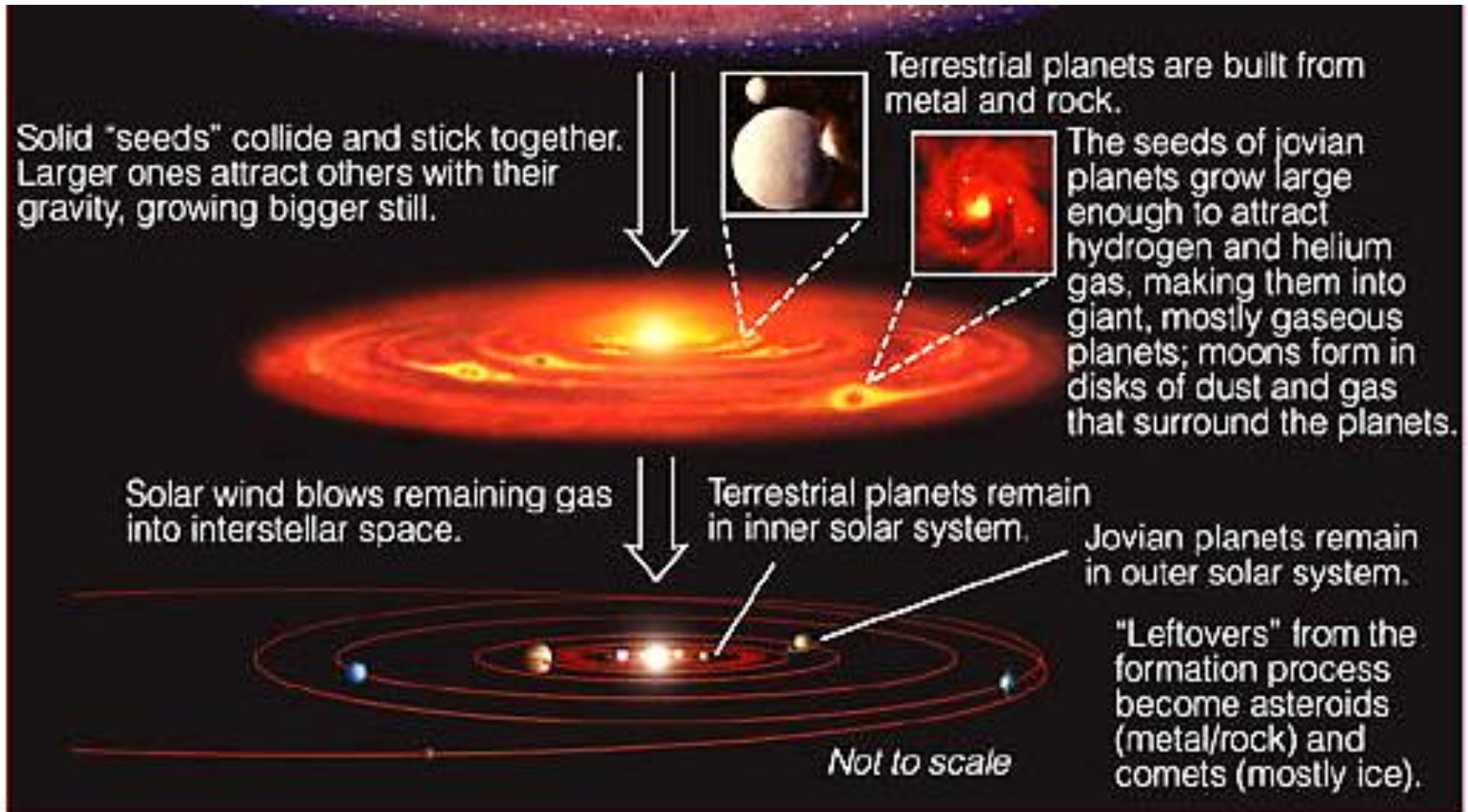
(~4.6 billion years ago)

Nebular Hypothesis



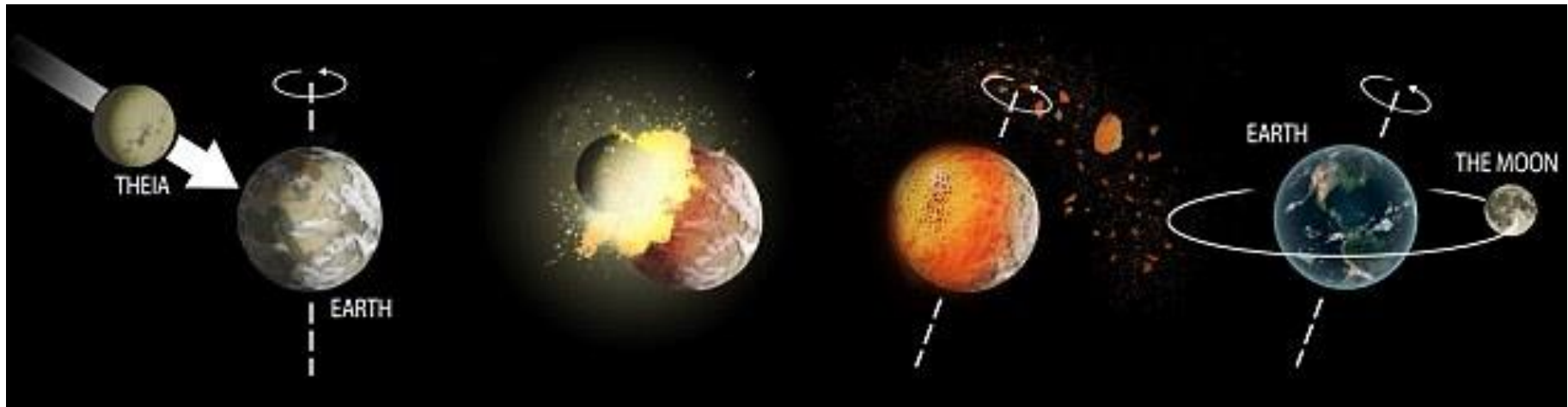
The Formation of the Solar System

The Sun, planets, moons, comets, asteroids are believed to form within 50-100 million years.



Formation of the Moon

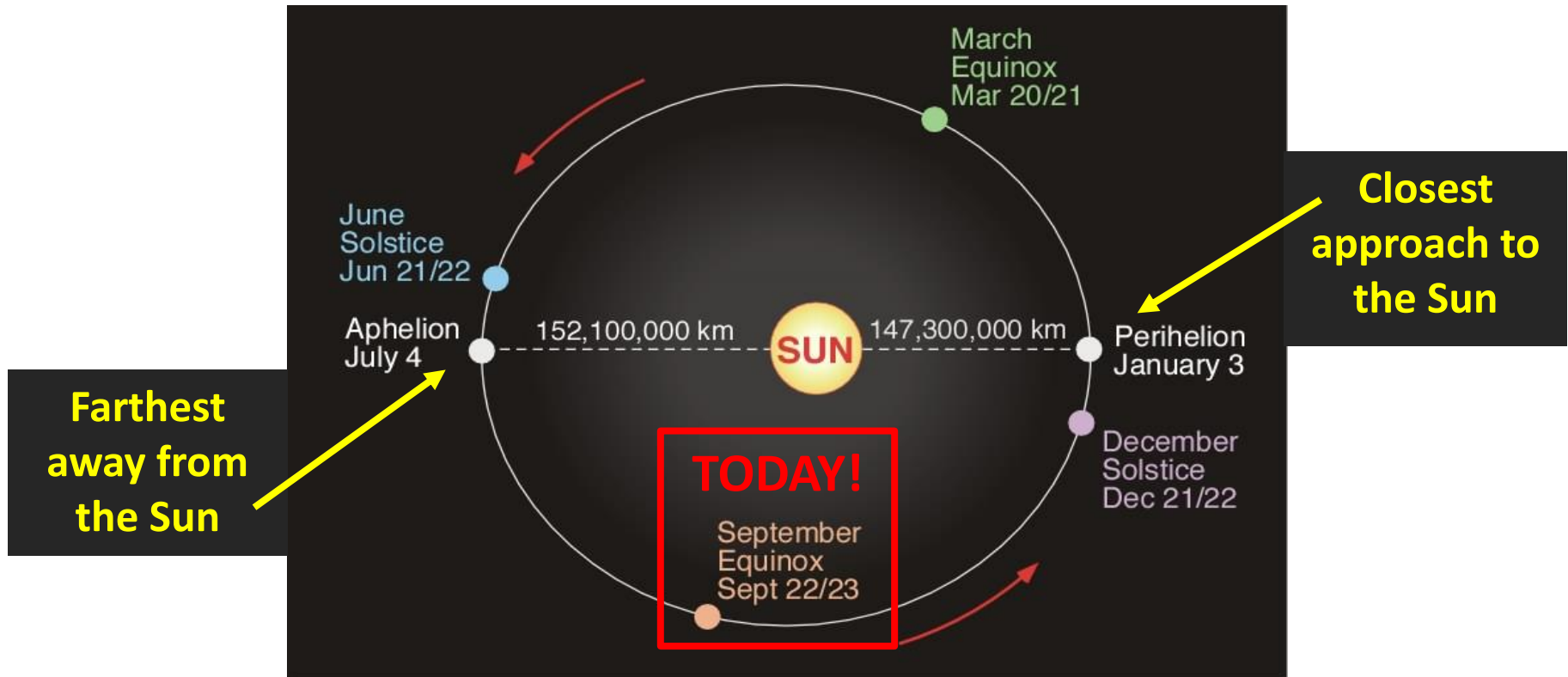
The Giant Impact Hypothesis



- Suggests that the Moon formed out of the debris left over from a **collision between Earth and an astronomical body the size of Mars**, approximately 4.5 billion years ago, about 20 to 100 million years after the Solar System coalesced.
- The colliding body is sometimes called **Theia**.
- **Fun Fact:** Earth and Moon have almost **identical composition!**

Earth Orbit

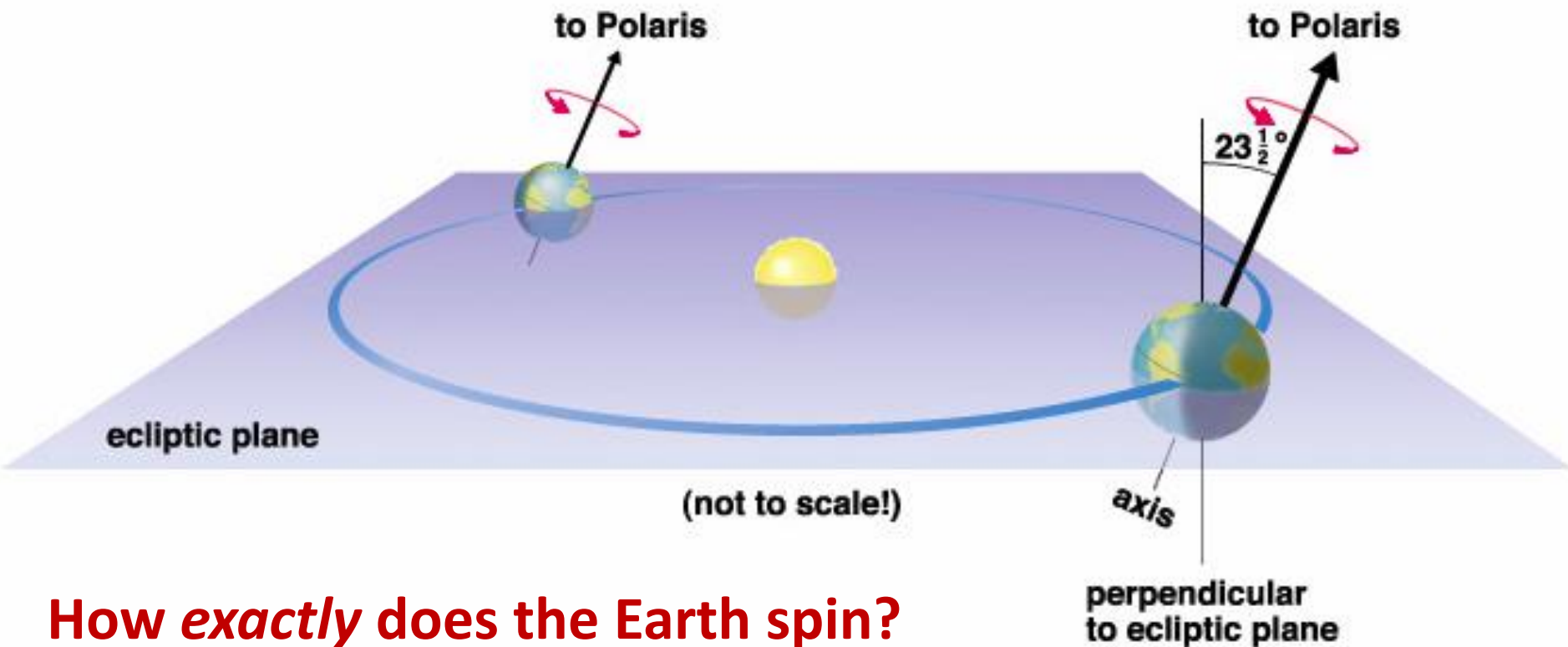
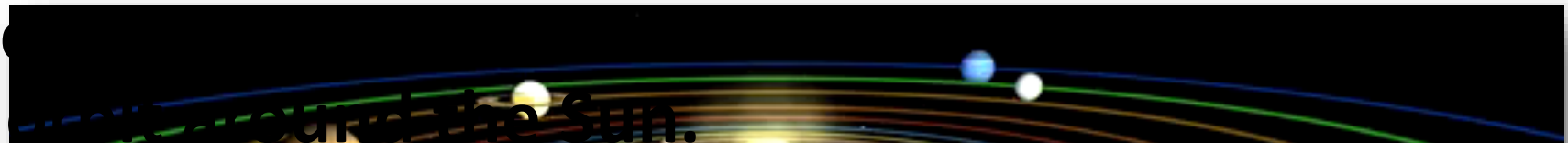
- The **orbit** of the Earth is *almost* a perfect circle: our mean distance to the Sun is about **150 million km** (~93 million mi).



- The **orbital speed** of the Earth (how fast it travels along its orbit around the Sun) is about **30 km/s** (~67,000 mph).

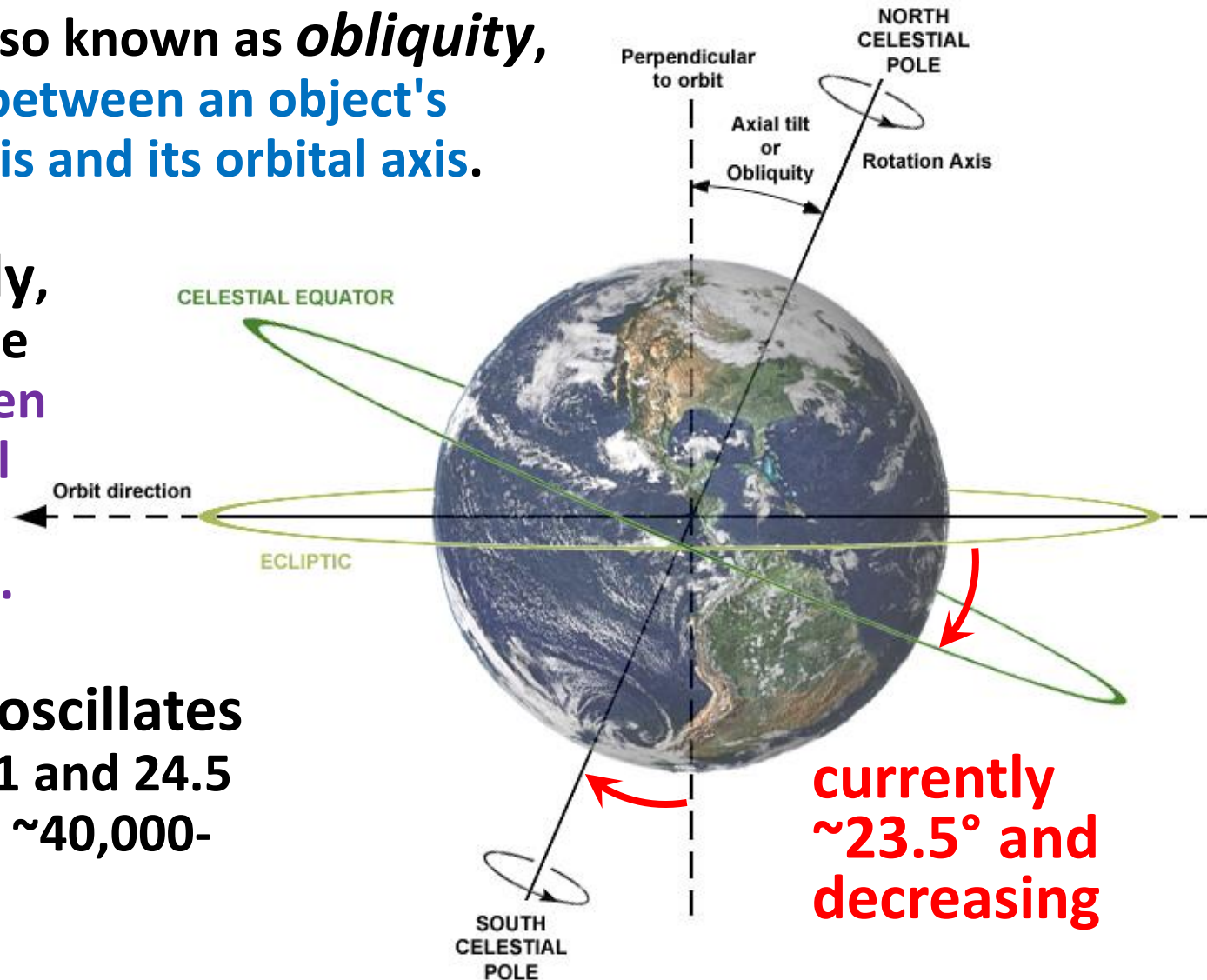
Ecliptic Plane

Imaginary plane



Earth Spin Axis Is Tilted!

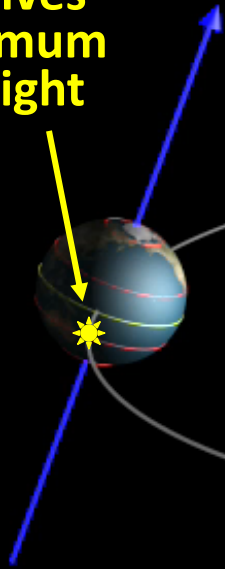
- Axial tilt, also known as *obliquity*, is the angle between an object's rotational axis and its orbital axis.
- Equivalently, axial tilt is the angle between its equatorial plane and orbital plane.
- Earth's tilt oscillates between 22.1 and 24.5 degrees on a ~40,000-year cycle.



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).

Arctic receives maximum sunlight



Equinox

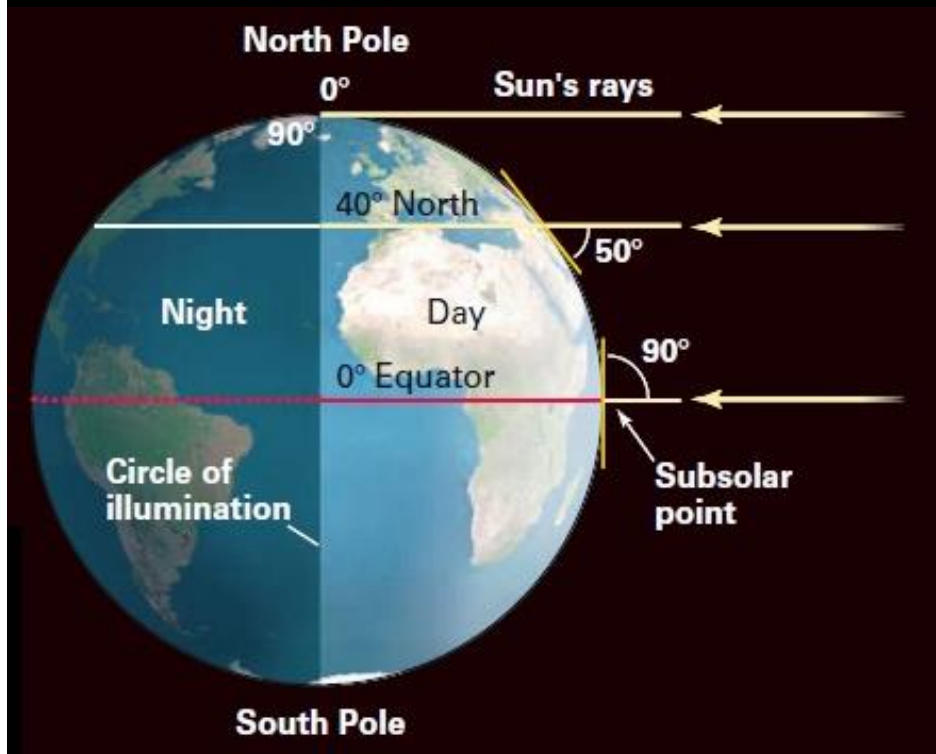
Equinox

Arctic receives NO sunlight

- 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.

Equinox conditions

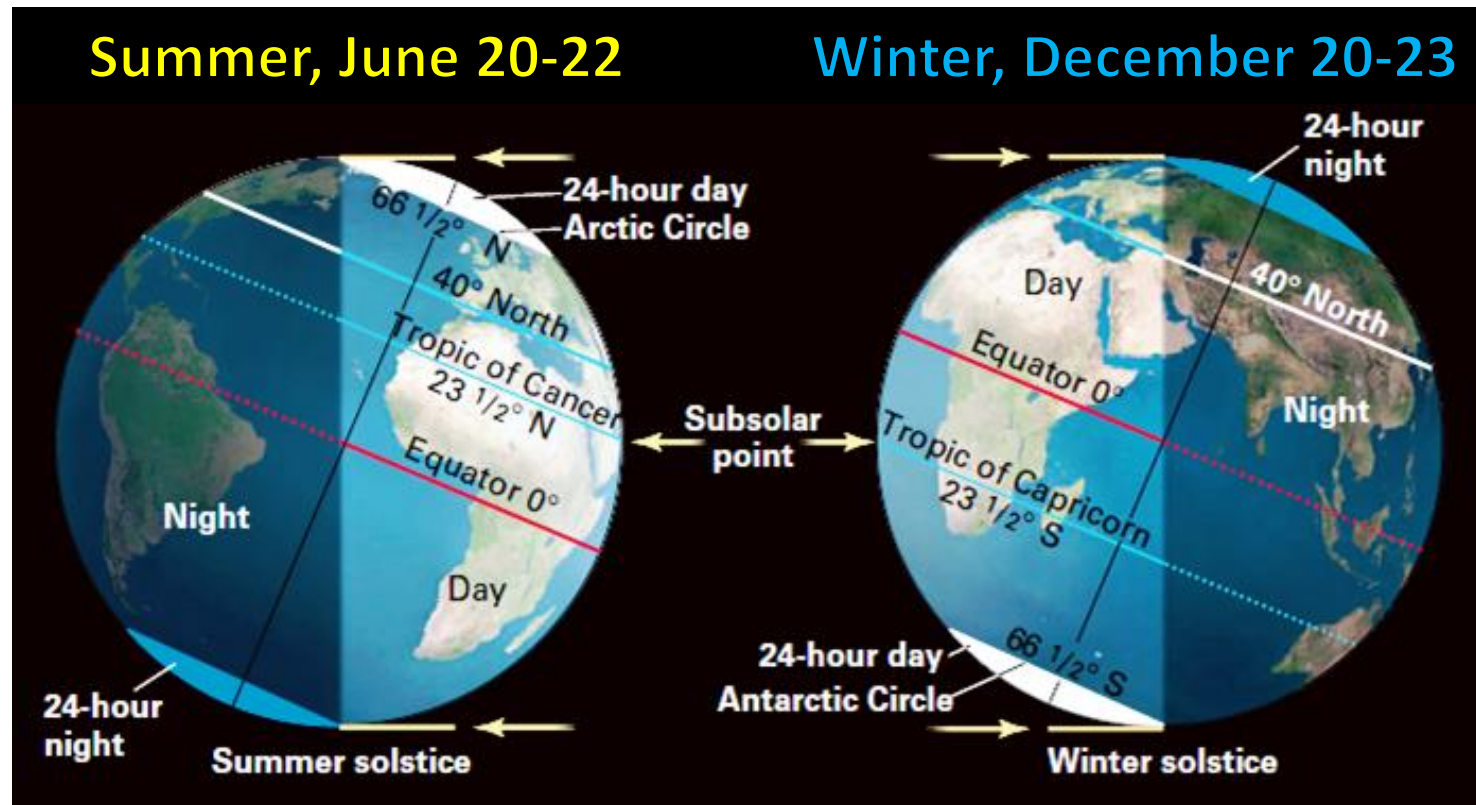
Autumnal (Fall), September 21-24
Vernal (Spring), March 20-23



- Both hemispheres are equally illuminated.

- 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.
- Day is equal to night everywhere on Earth.
- At both poles the Sun is seen at the horizon.

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.
- The Sun is directly overhead at noon on one of the tropics.