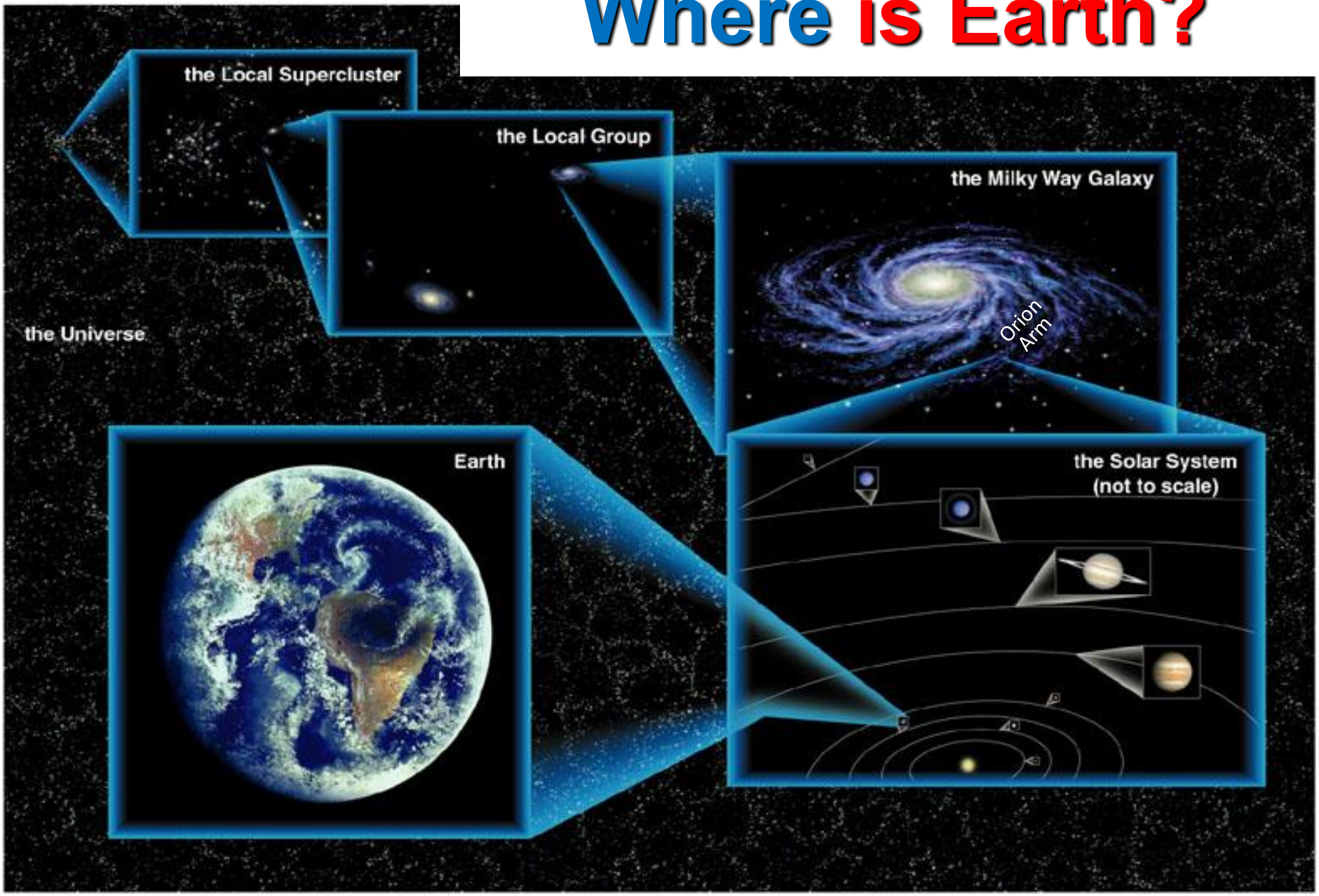
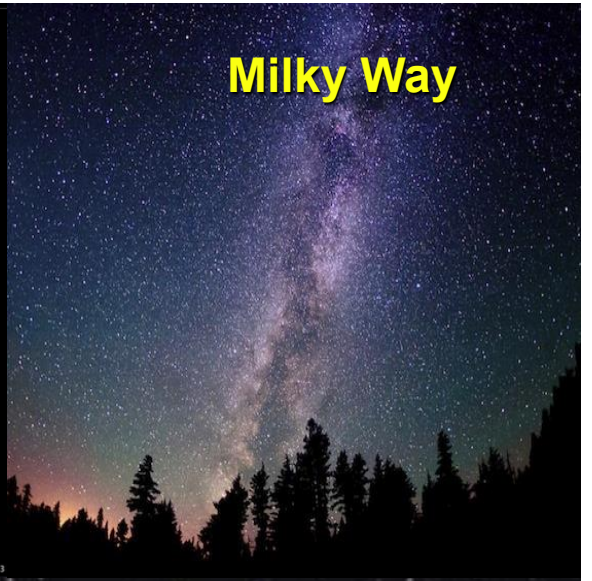
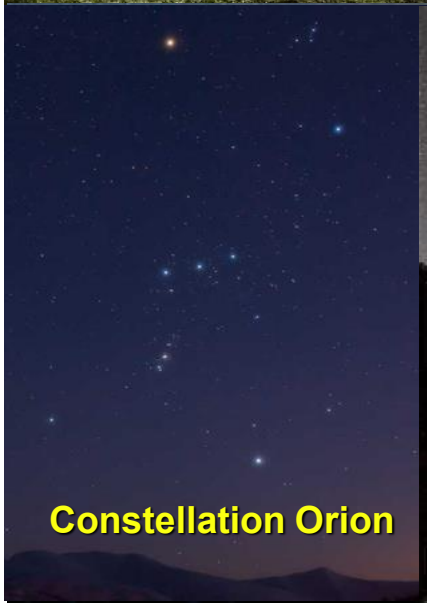
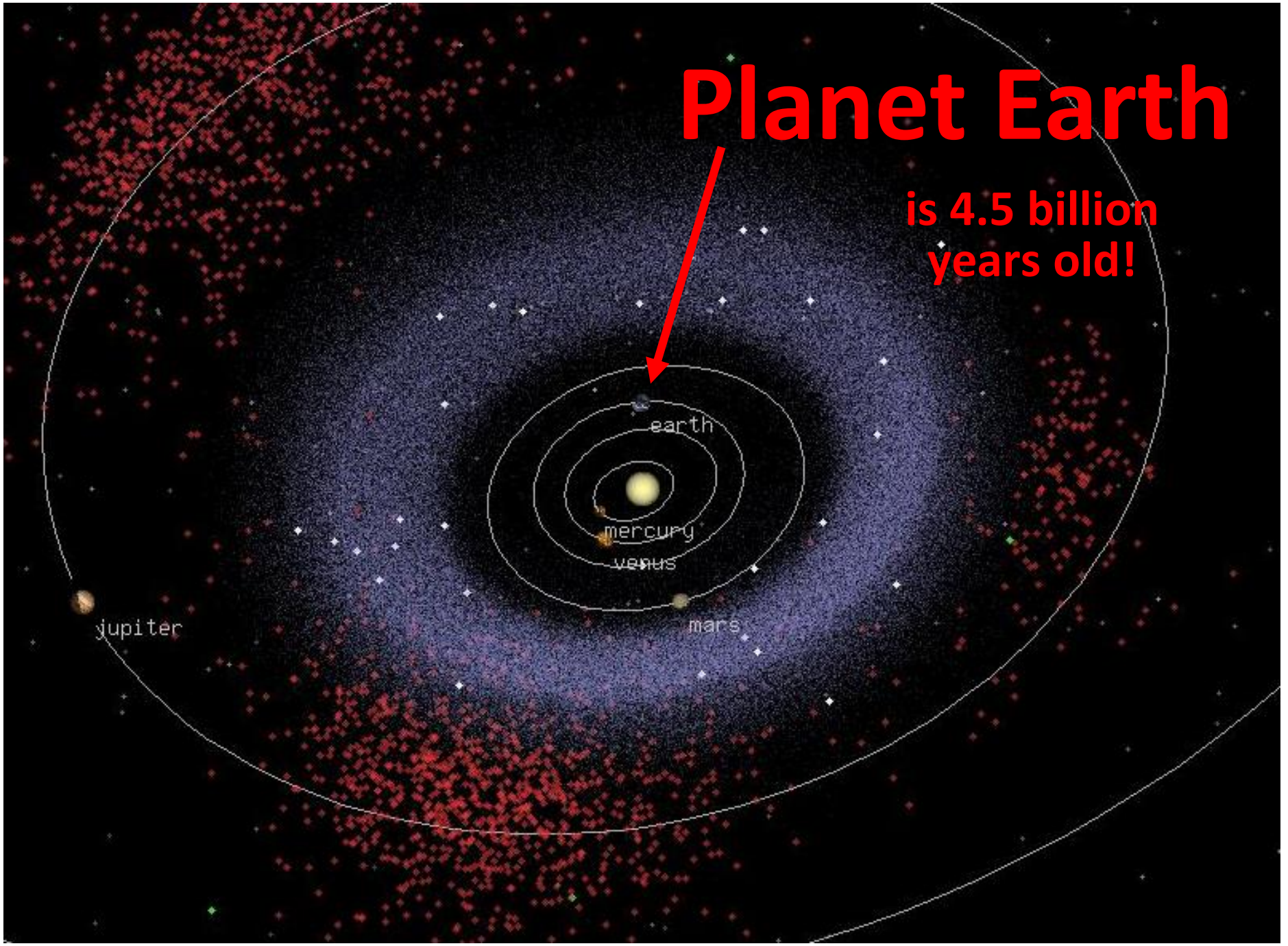
Where is Earth?



What do we see from Earth?



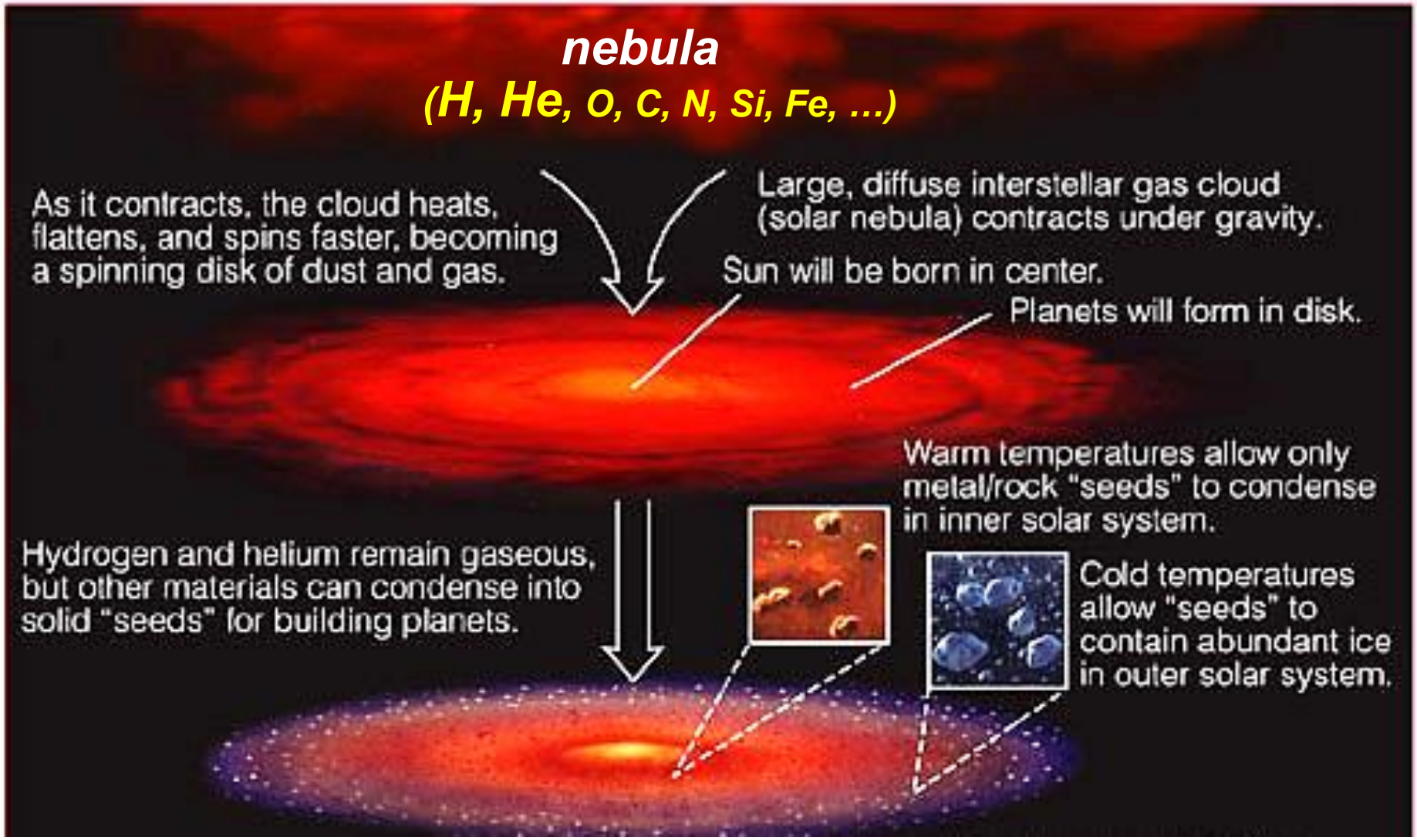



Planet Earth
is 4.5 billion years old!
earth
mercury
venus
mars
jupiter

The Formation of the Solar System

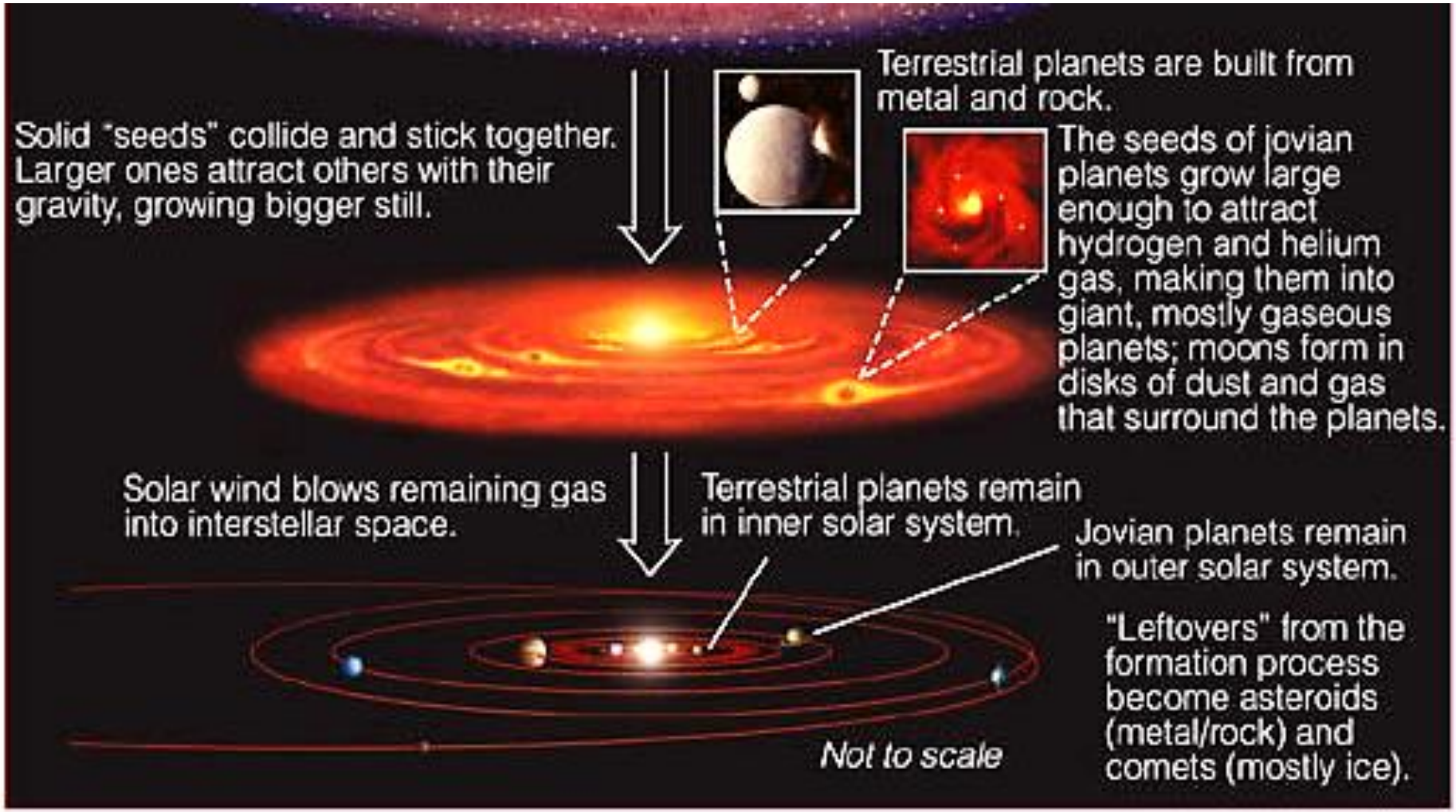
(~4.6 billion years ago)

Nebular Hypothesis



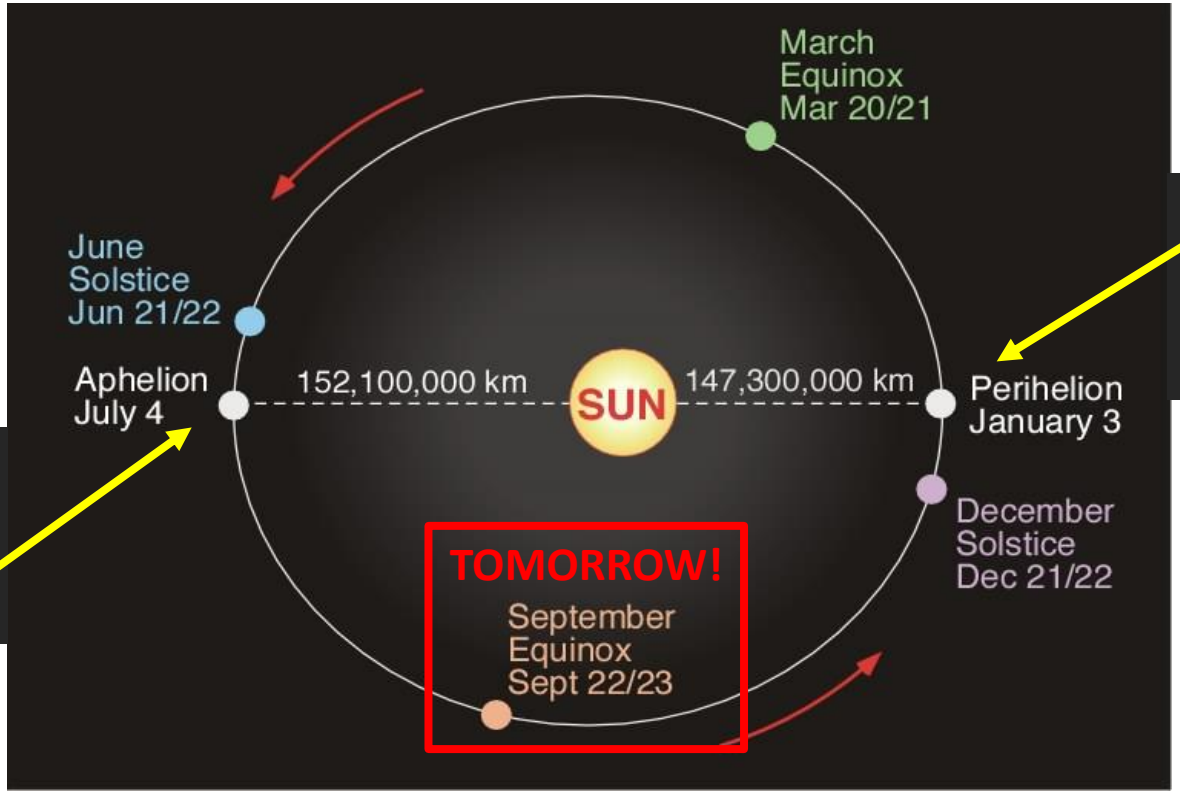
The Formation of the Solar System

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



Earth Orbit

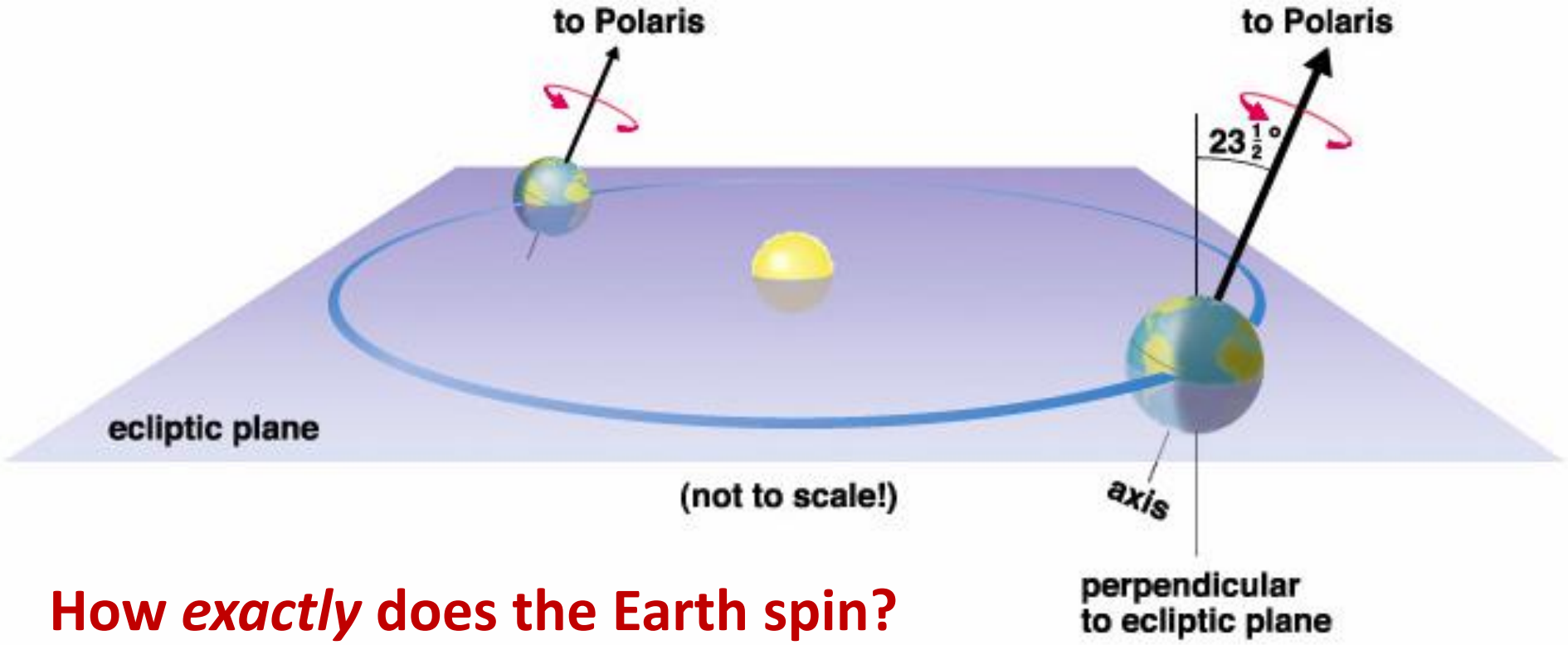
- The orbit of the Earth is *almost* a perfect circle: our mean distance to the Sun is about 150 million km (~93 million mi).



- 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

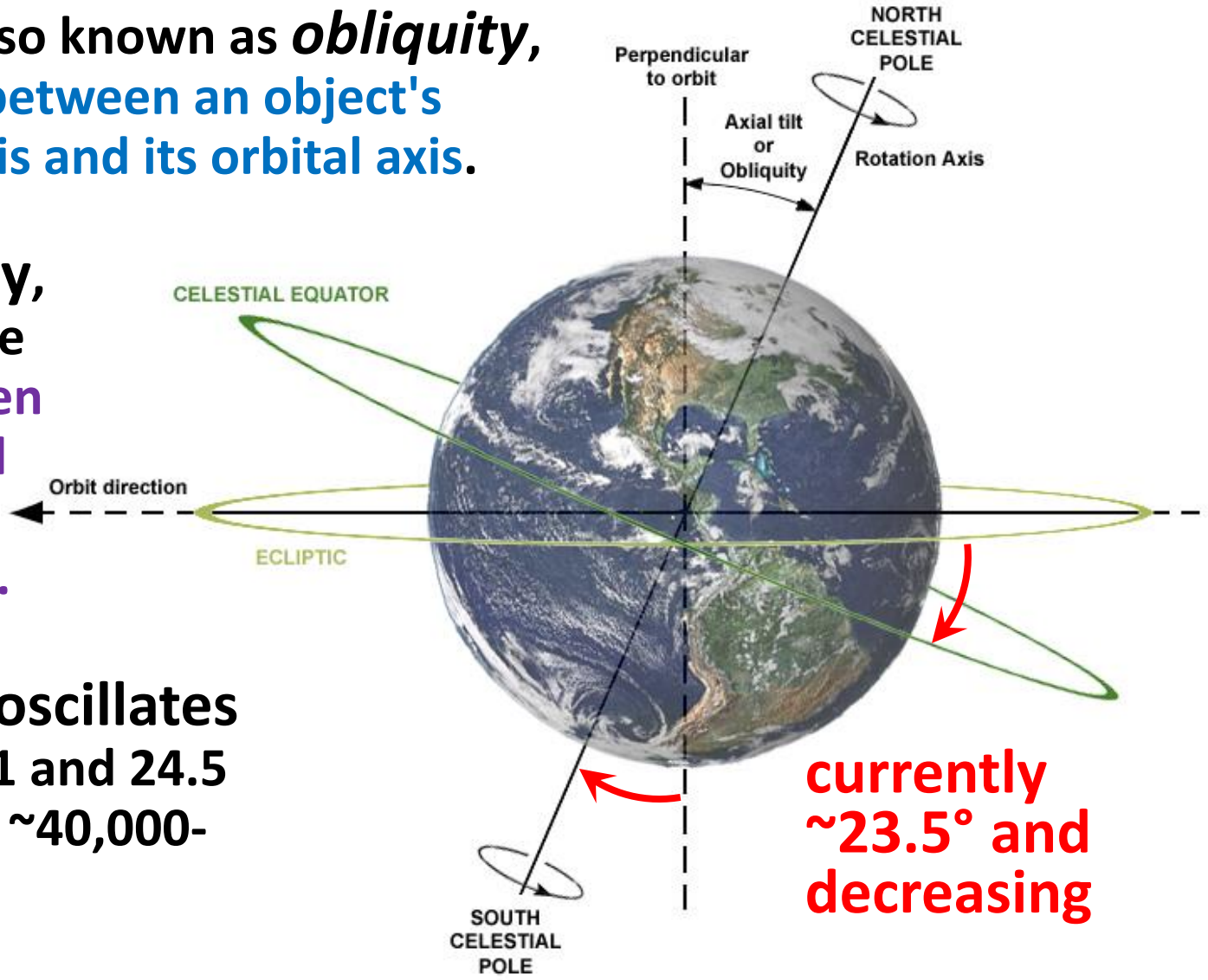
Imaginary plane



How *exactly* does the Earth spin?

Earth Spin Axis Is Tilted!

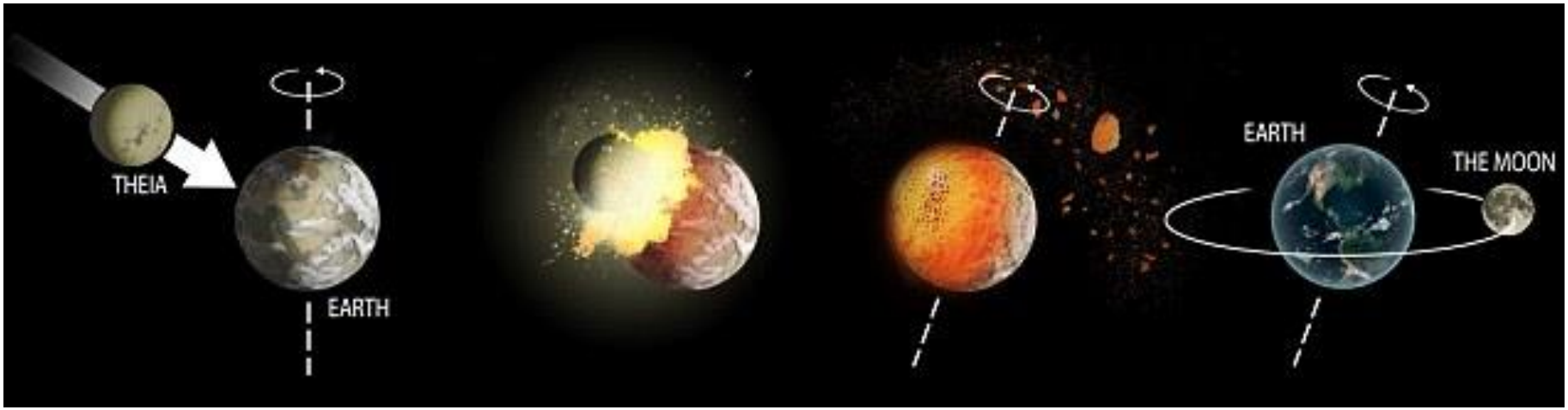
- **Axial tilt**, also known as ***obliquity***, is the angle between an object's rotational axis and its orbital axis.
- **Equivalently,** axial tilt is the angle between its equatorial plane and orbital plane.
- **Earth's tilt oscillates** between 22.1 and 24.5 degrees on a ~40,000-year cycle.



currently ~23.5° and decreasing

Formation of the Moon

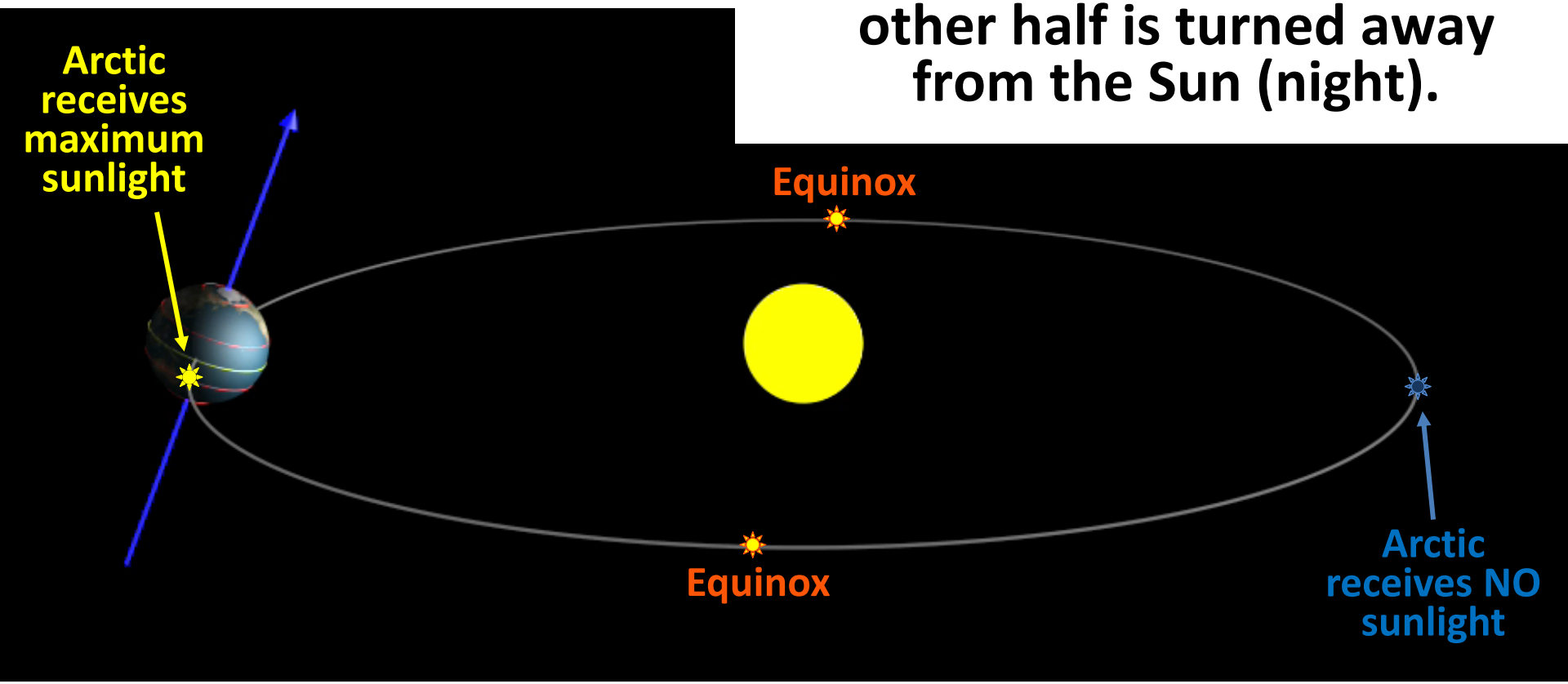
The Giant Impact Hypothesis



- **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!**

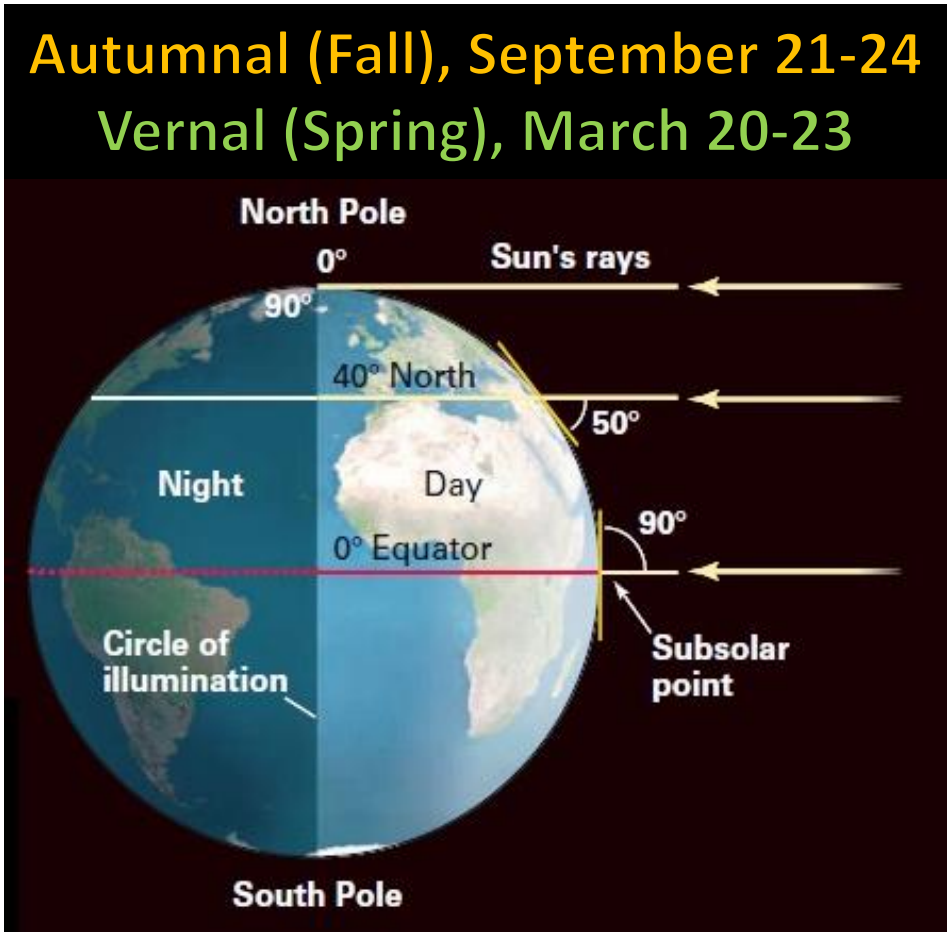
Day and Night

- 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 <u>circle of illumination</u> *(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.

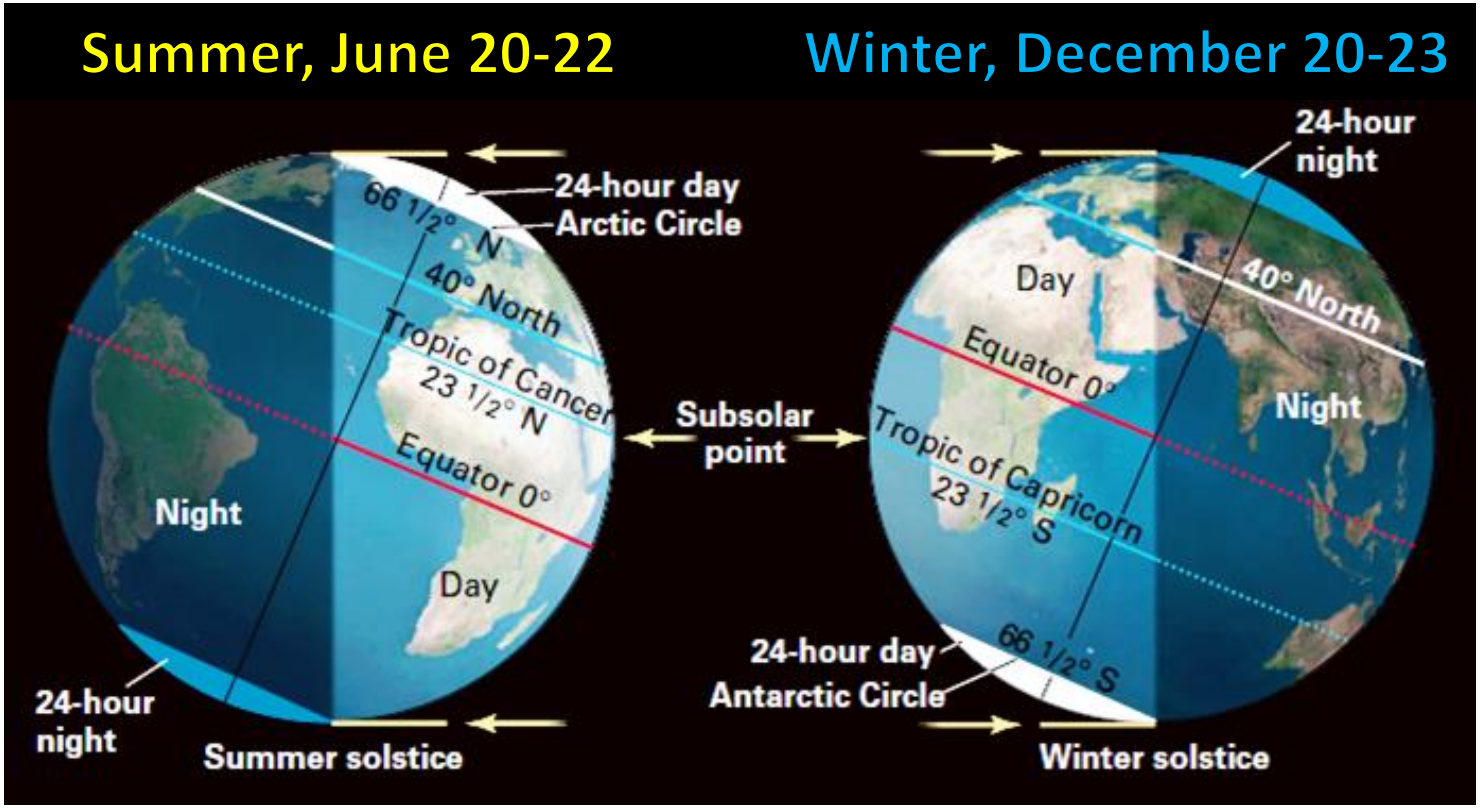
Equinox conditions



- 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.
- <u>The Sun is directly overhead at noon on one of the tropics</u>.