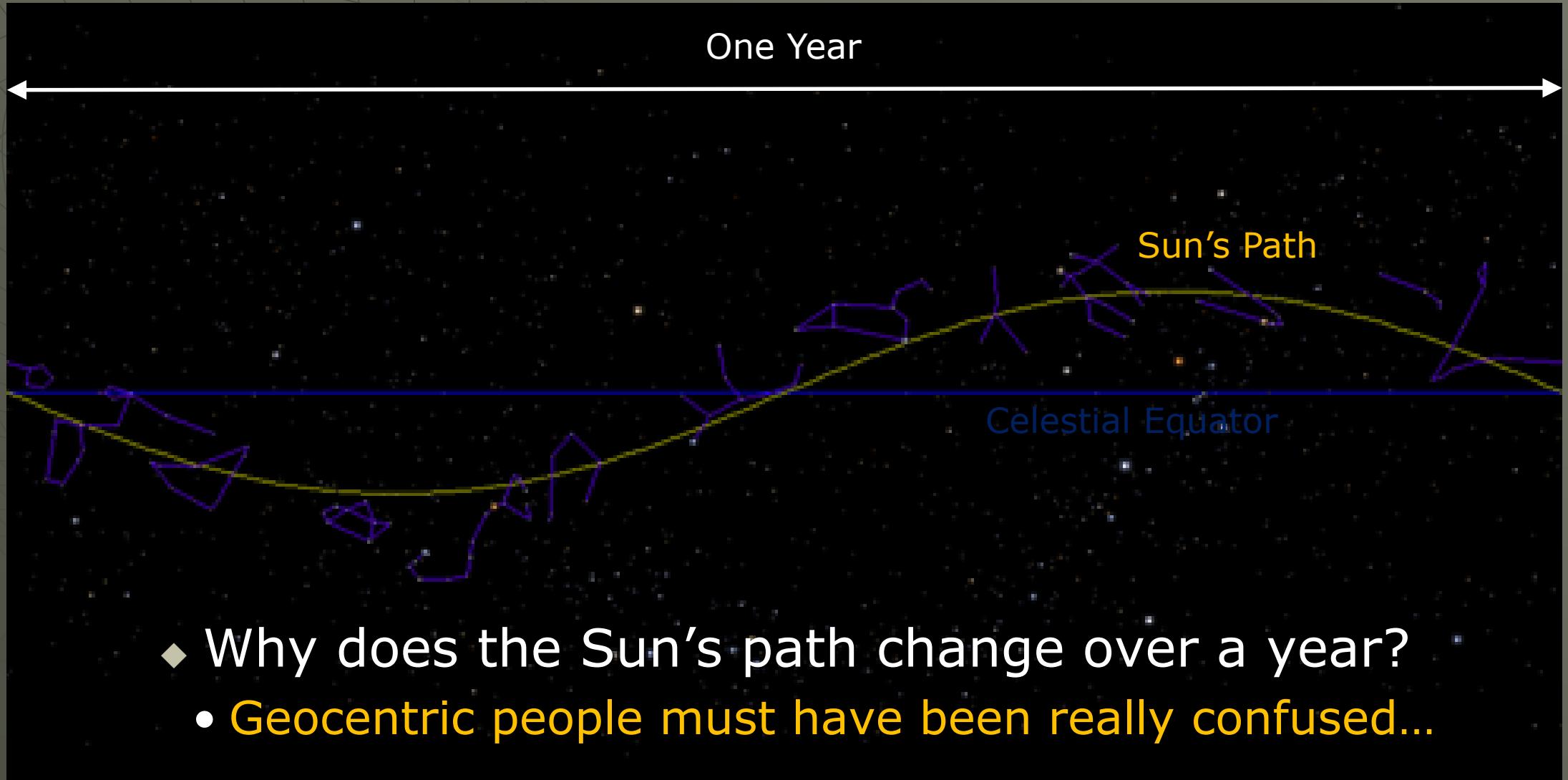


Path of the Sun

◆ Objectives

- How and Why does the Sun change its altitude and position over a year
- What are the Effects of these changes

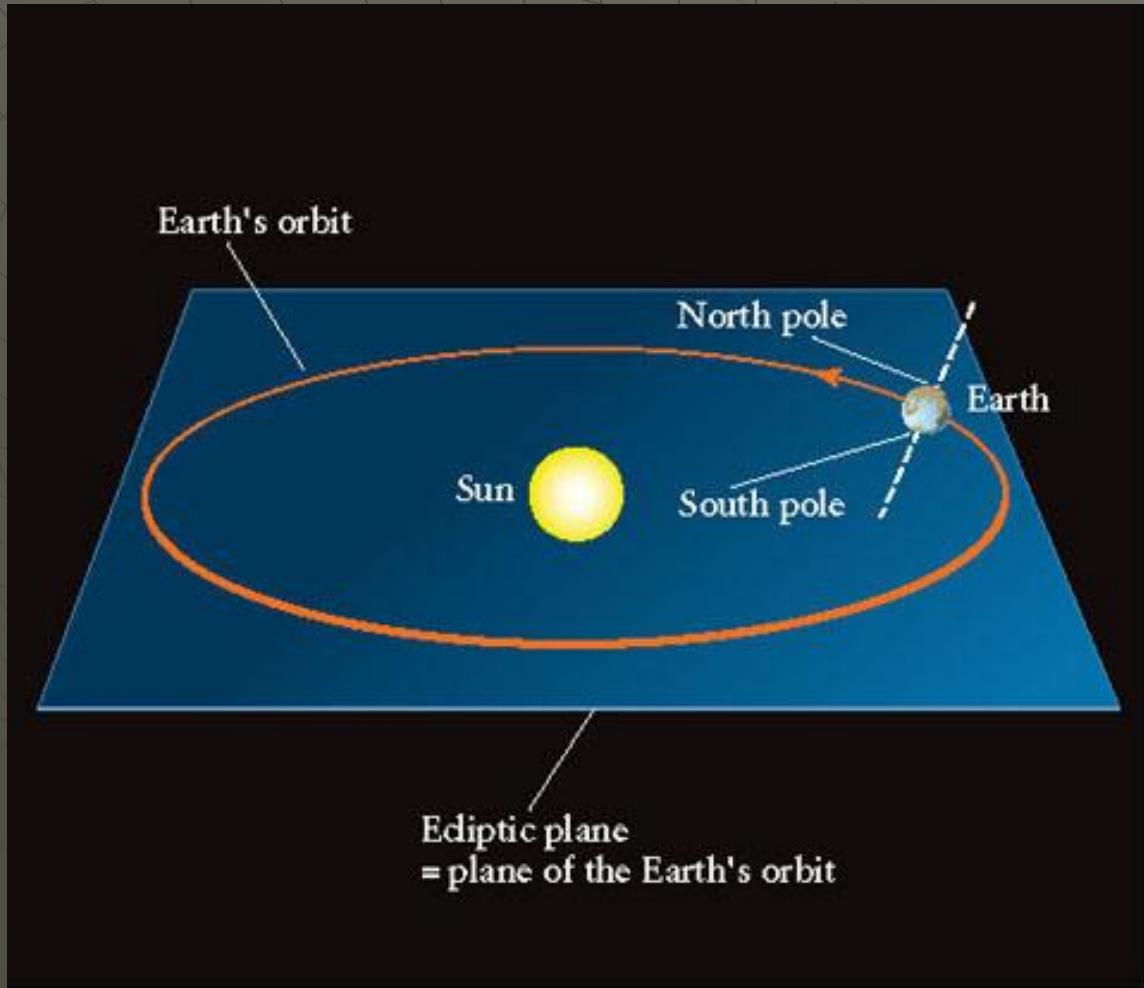
Sun's Doesn't Cover the Same Constellations!



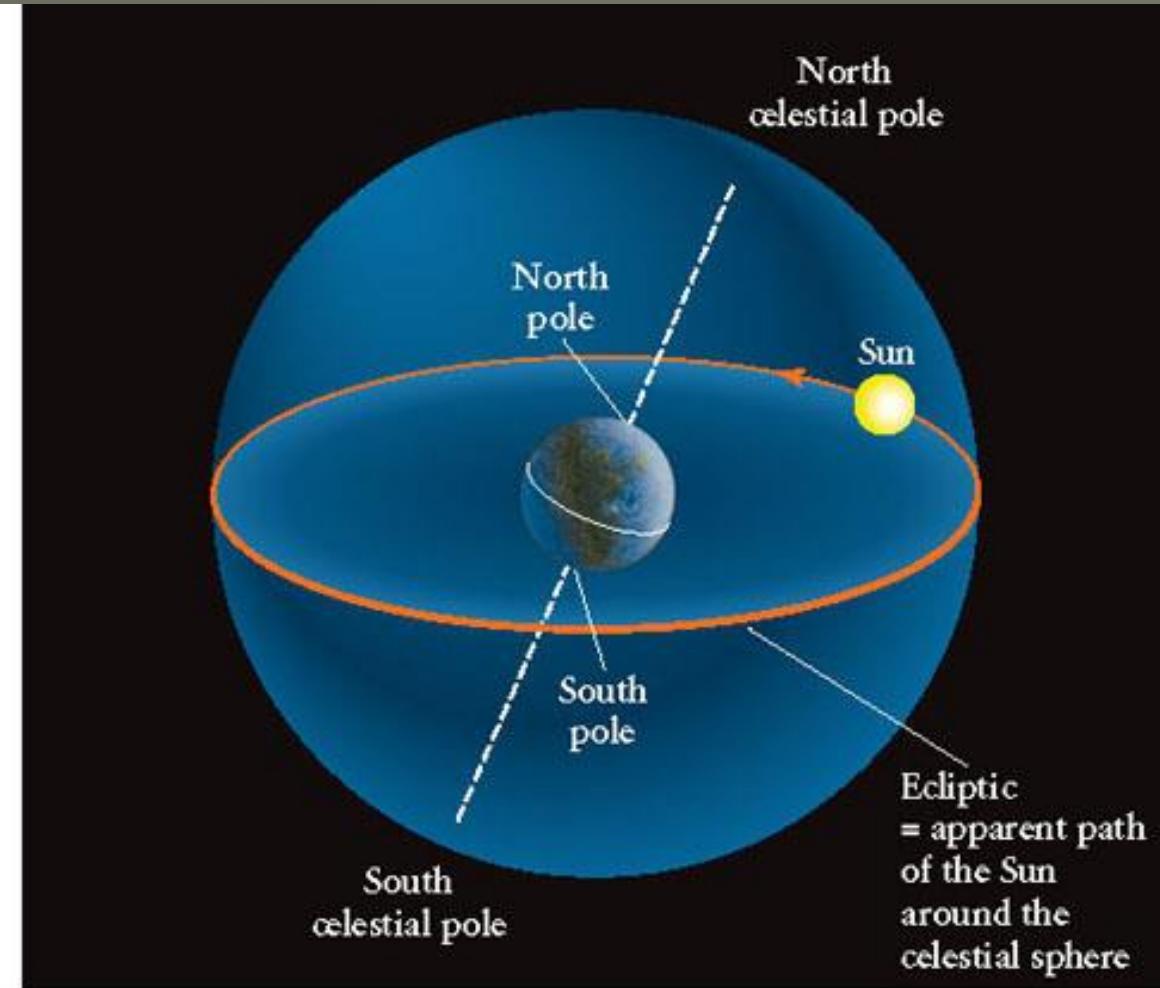
Get out of the way, Sun!

- ◆ As earth orbits the sun, the sun appears to be in front of certain constellations
 - **Zodiac** constellations
- ◆ We see constellations that are “away” from the sun

The Earth Orbits the Sun



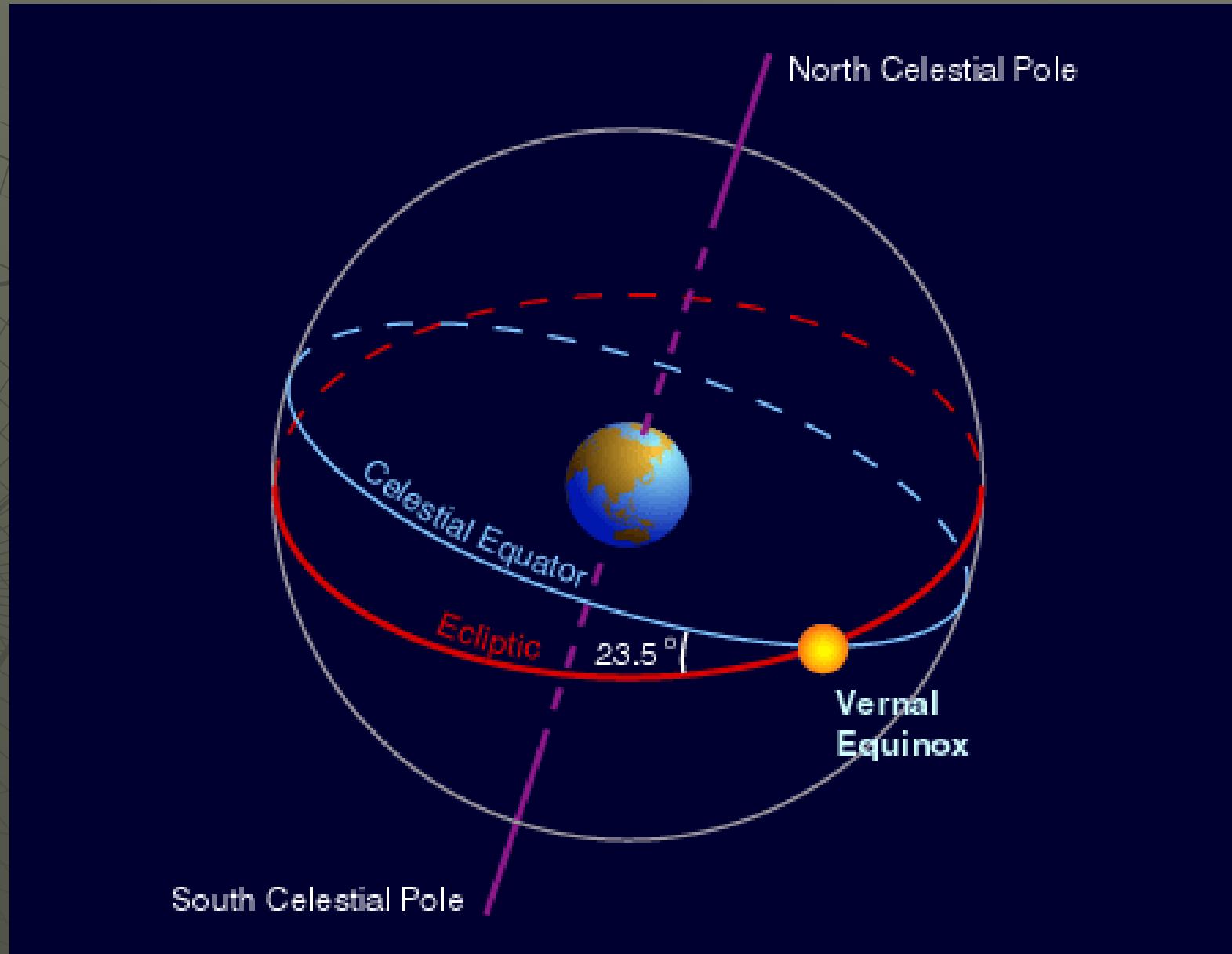
(a) In reality the Earth orbits the Sun once a year



(b) It appears to us that the Sun travels around the celestial sphere once a year

Ecliptic

- **Ecliptic:** the plane of solar system
 - Includes: Sun, planets, and zodiac constellations
 - Earth's orbit is tilted at 23.5 degrees

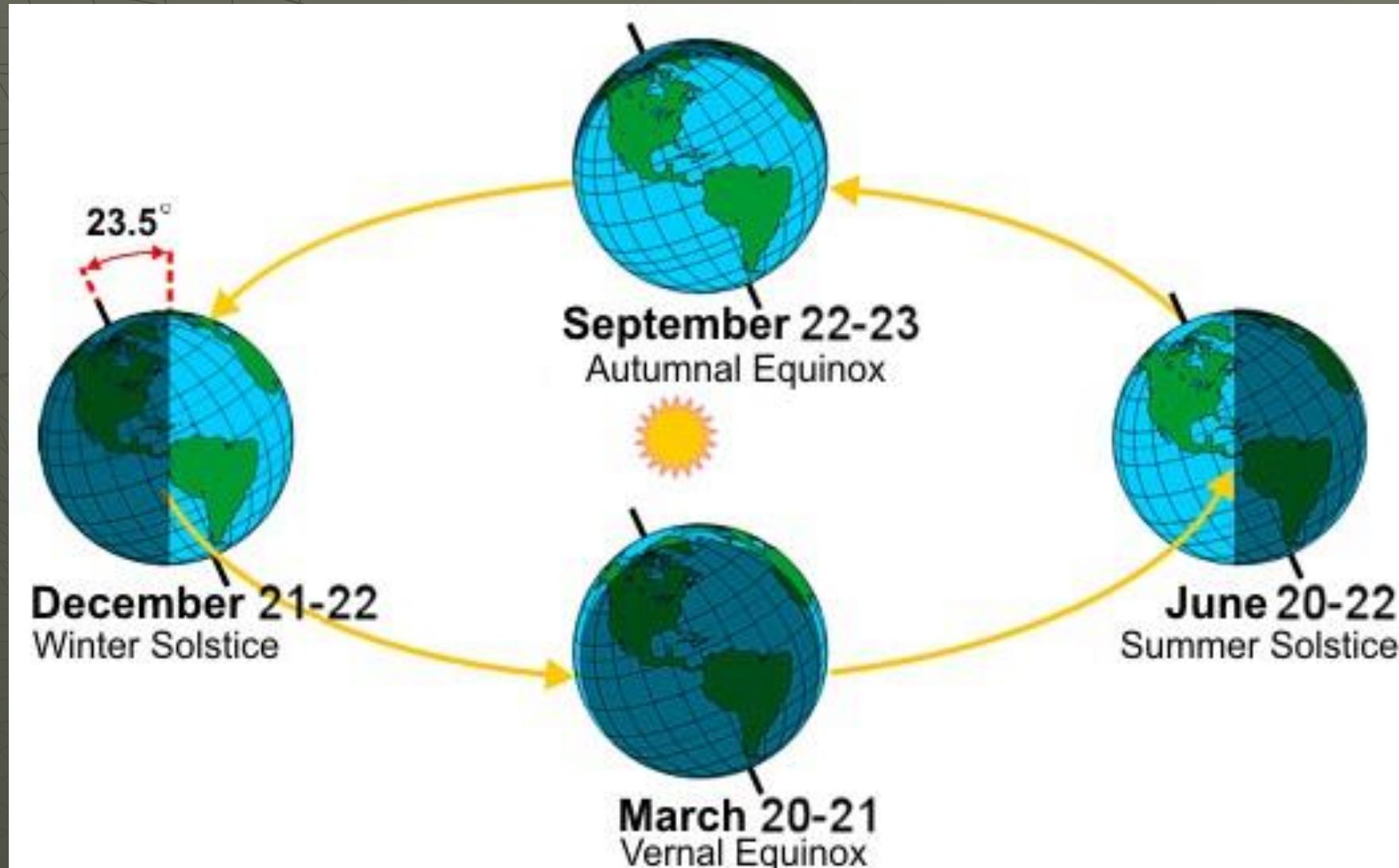


Earth's Orbit

Sun is
Lowest in
N Hemisphere

Sun crosses
Celestial equator

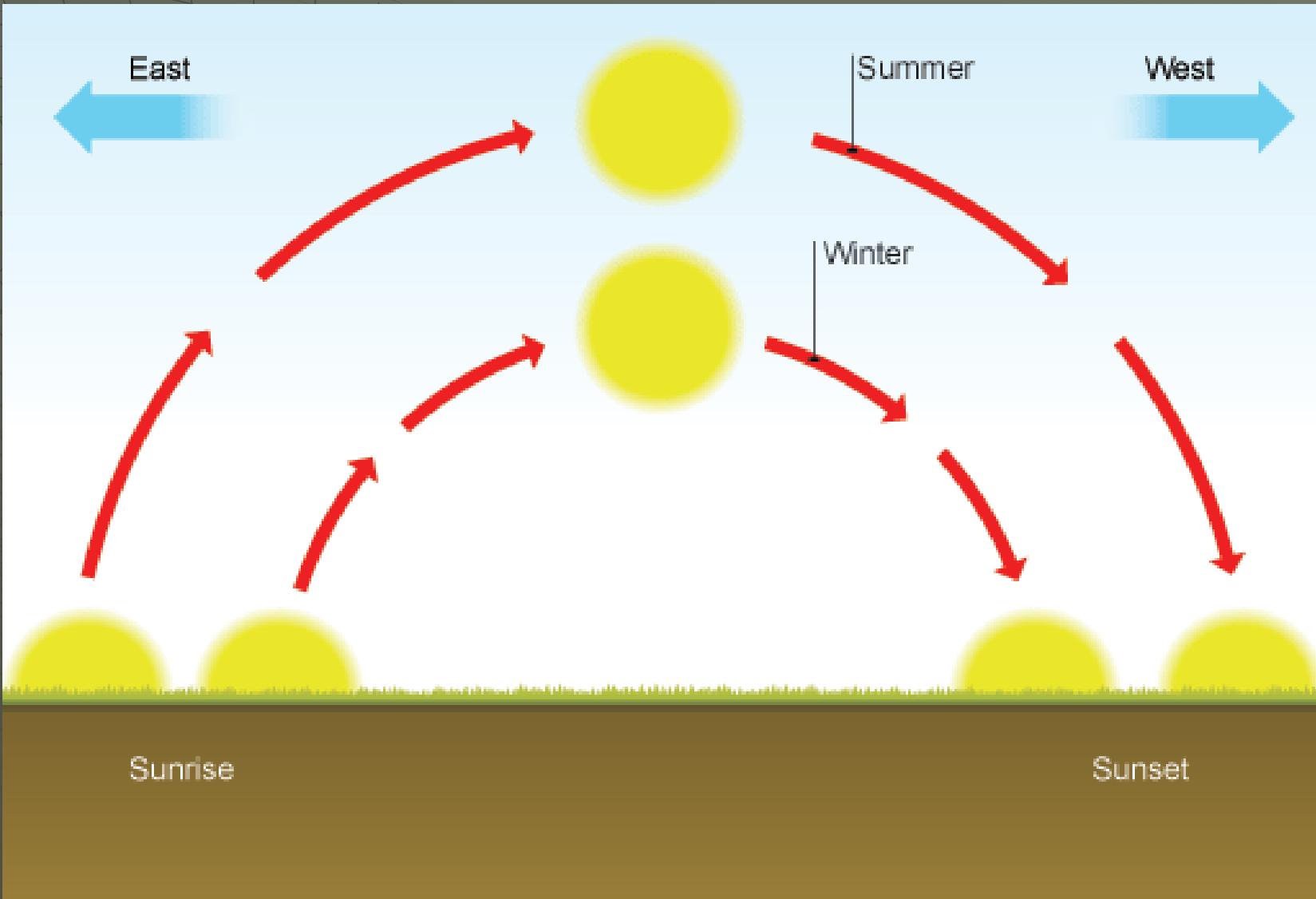
Sun is
Highest in
N Hemisphere



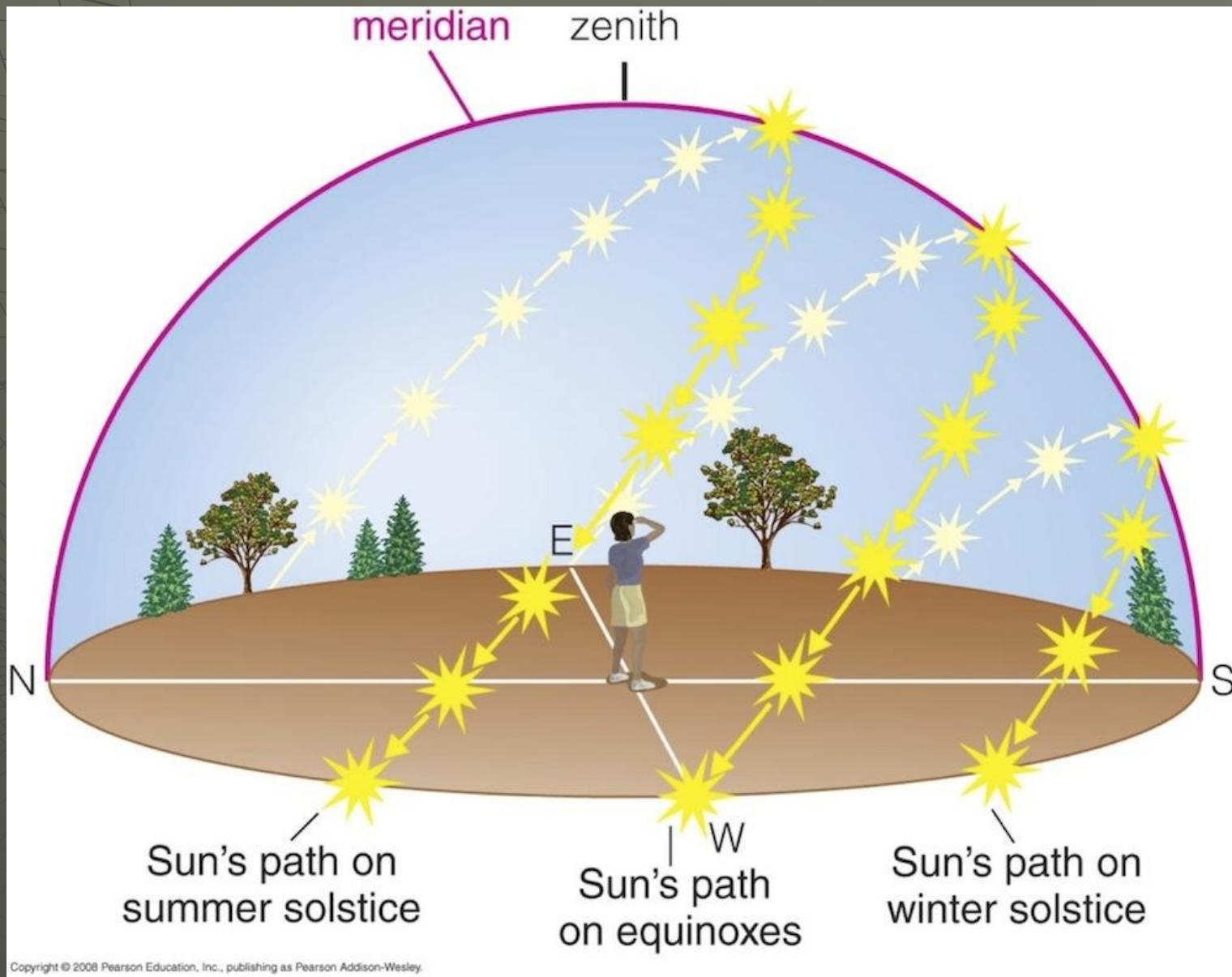
LT

- ◆ Ecliptic
 - pg 13

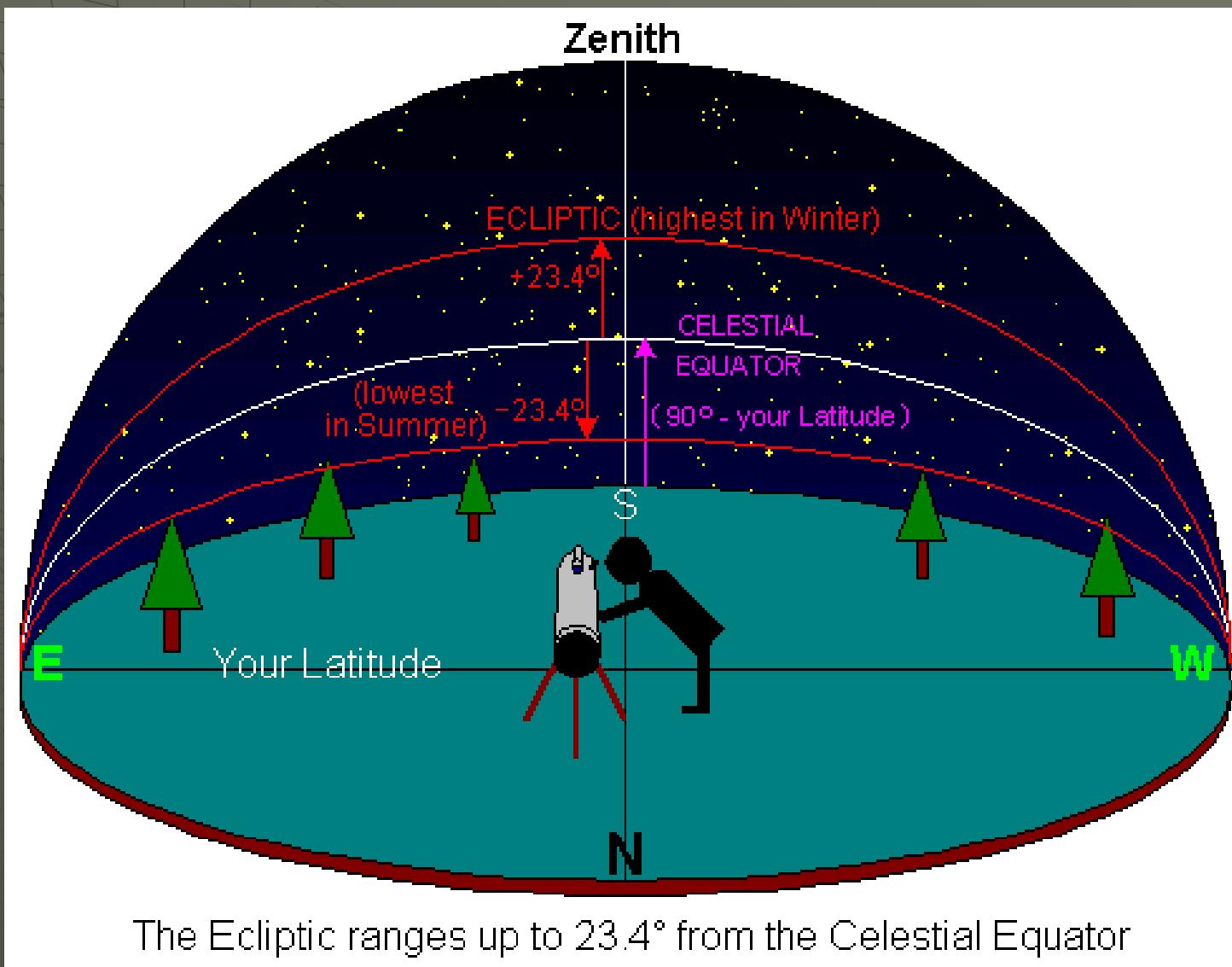
Sun's Path at Different Times of the Year



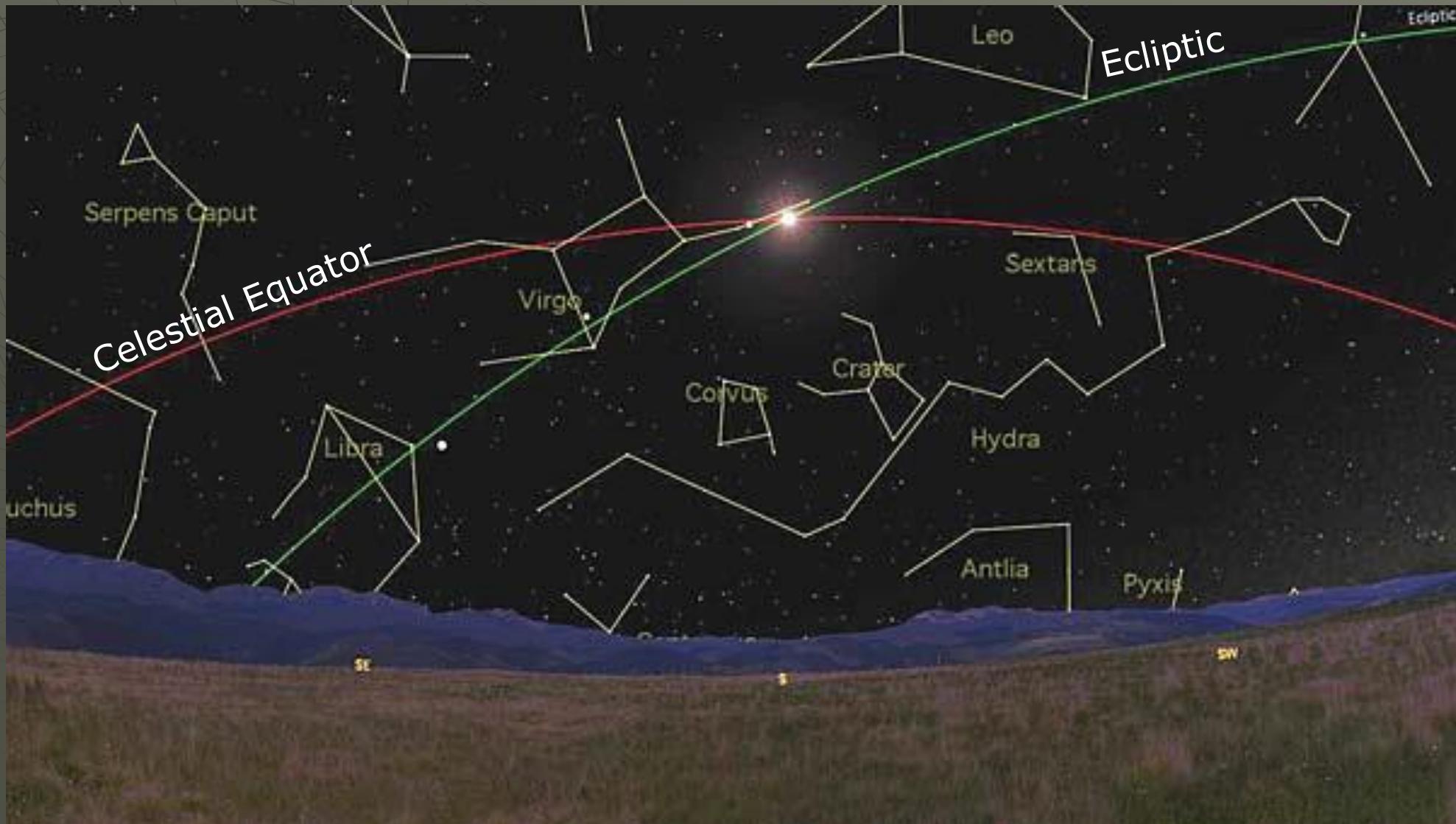
Solstice & Equinox



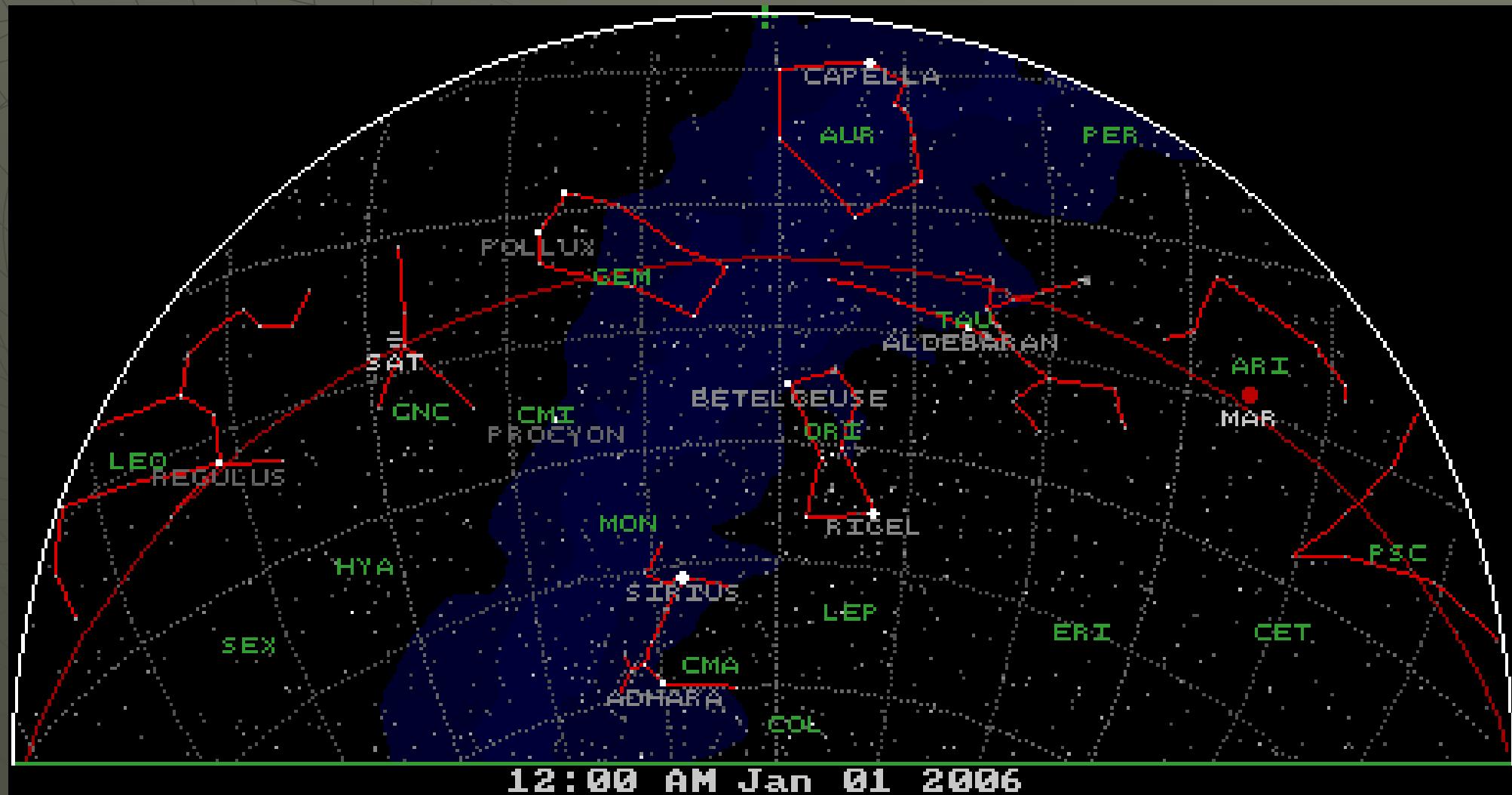
Solstices



Equinox



Ecliptic Animation

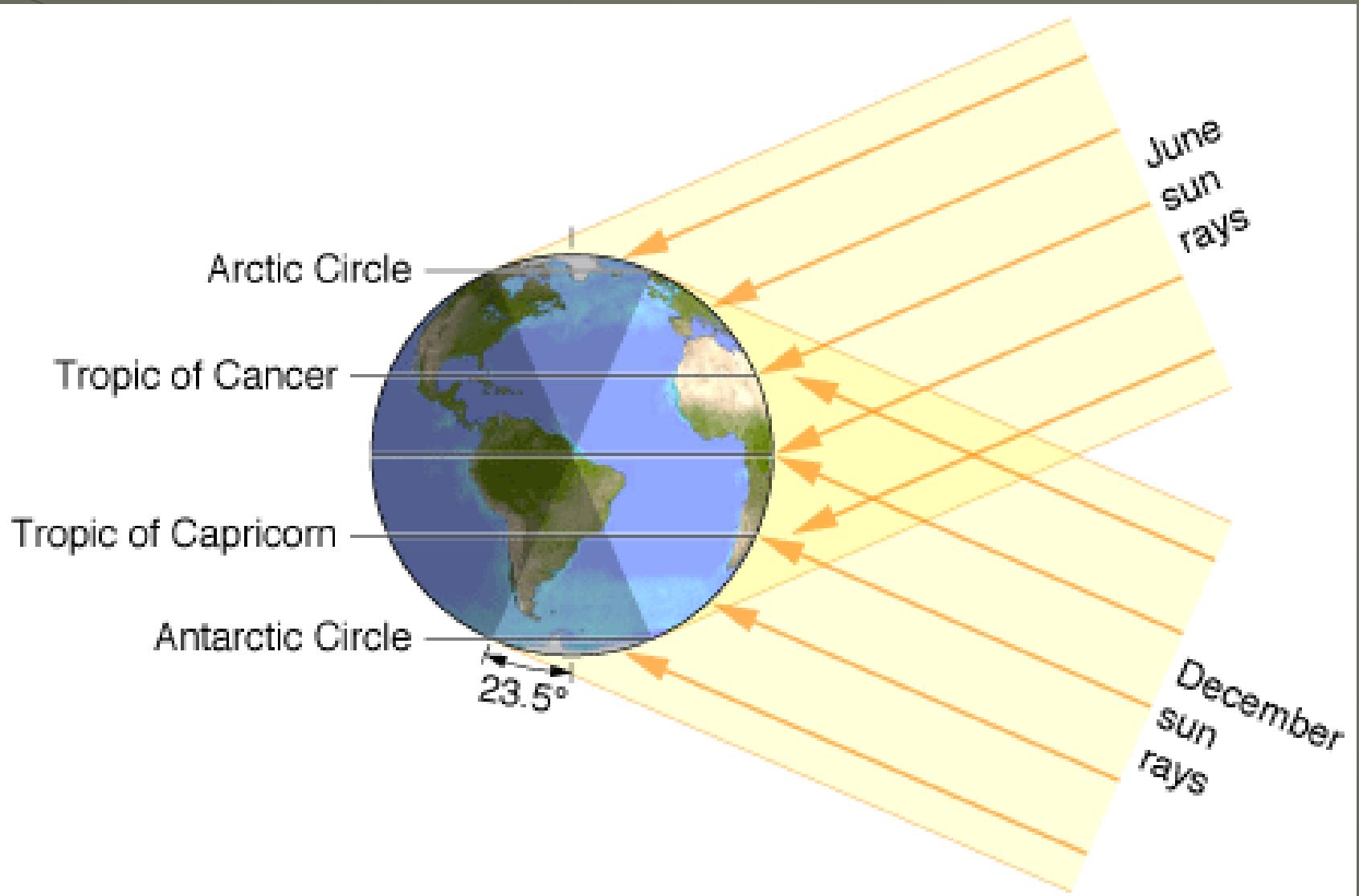


Changing Declination of the Sun

- ◆ Throughout year, sun slowly changes its north/south position.
 1. Summer Solstice (June 21st) : Sun 23.5° above (*north of*) celestial equator
 2. Autumnal Equinox (Sept. 21st): Sun *on* celestial equator
 3. Winter Solstice (Dec. 21st): Sun 23.5° below (*south of*) celestial equator
 4. Vernal Equinox (March 21st): Sun *on* celestial equator

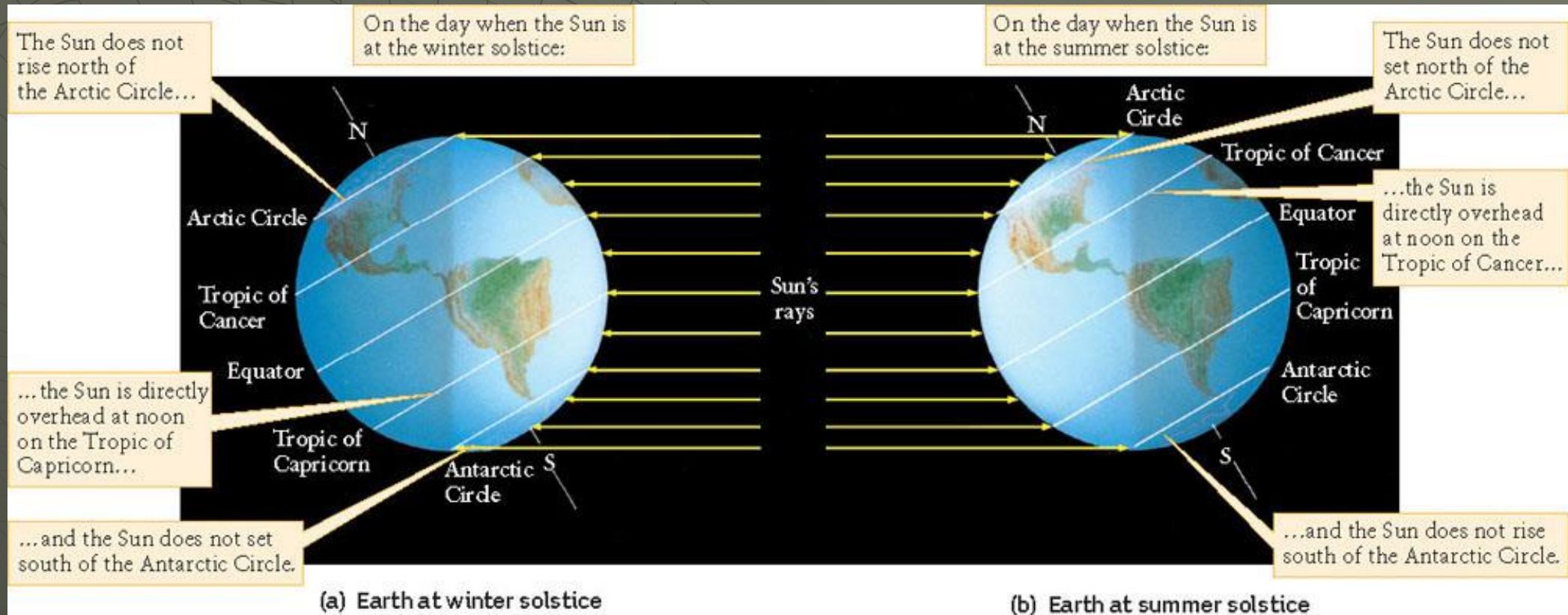
The Sun from Different Latitudes

- Tropic of Cancer:
 - Sun is directly overhead during the summer solstice
- Tropic o Capricorn:
 - Sun is directly overhead during the winter solstice



Circumpolar Sun!

At some locations and times, even the sun is circumpolar or does not rise!



LT

- ◆ Seasonal Stars
 - Pg 7

TPS

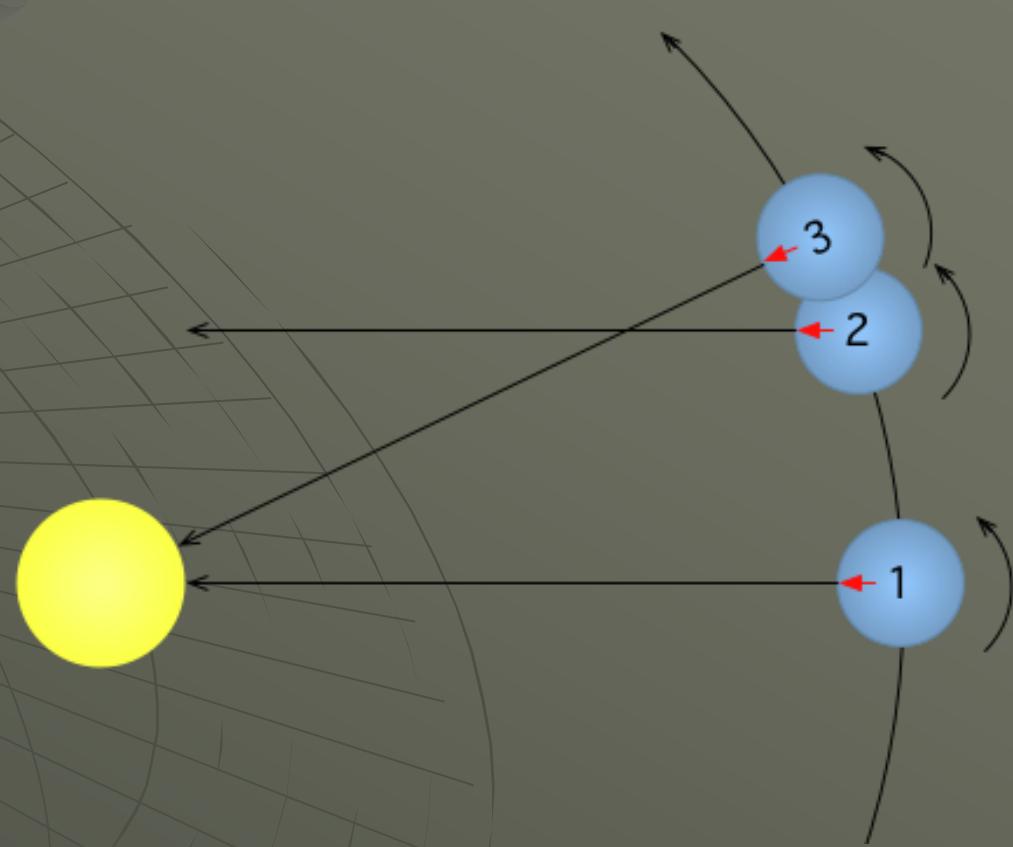
Q: The Sun never _____ above the _____ circle on the Winter Solstice?

- A) rises, antarctic
- B) sets, antarctic
- C) rises, arctic
- D) B and C

Sidereal Day

- Days are defined from when the Sun crosses the Local Meridian: 24 hours
- **But the stars take 23 hours and 56 minutes!!!**

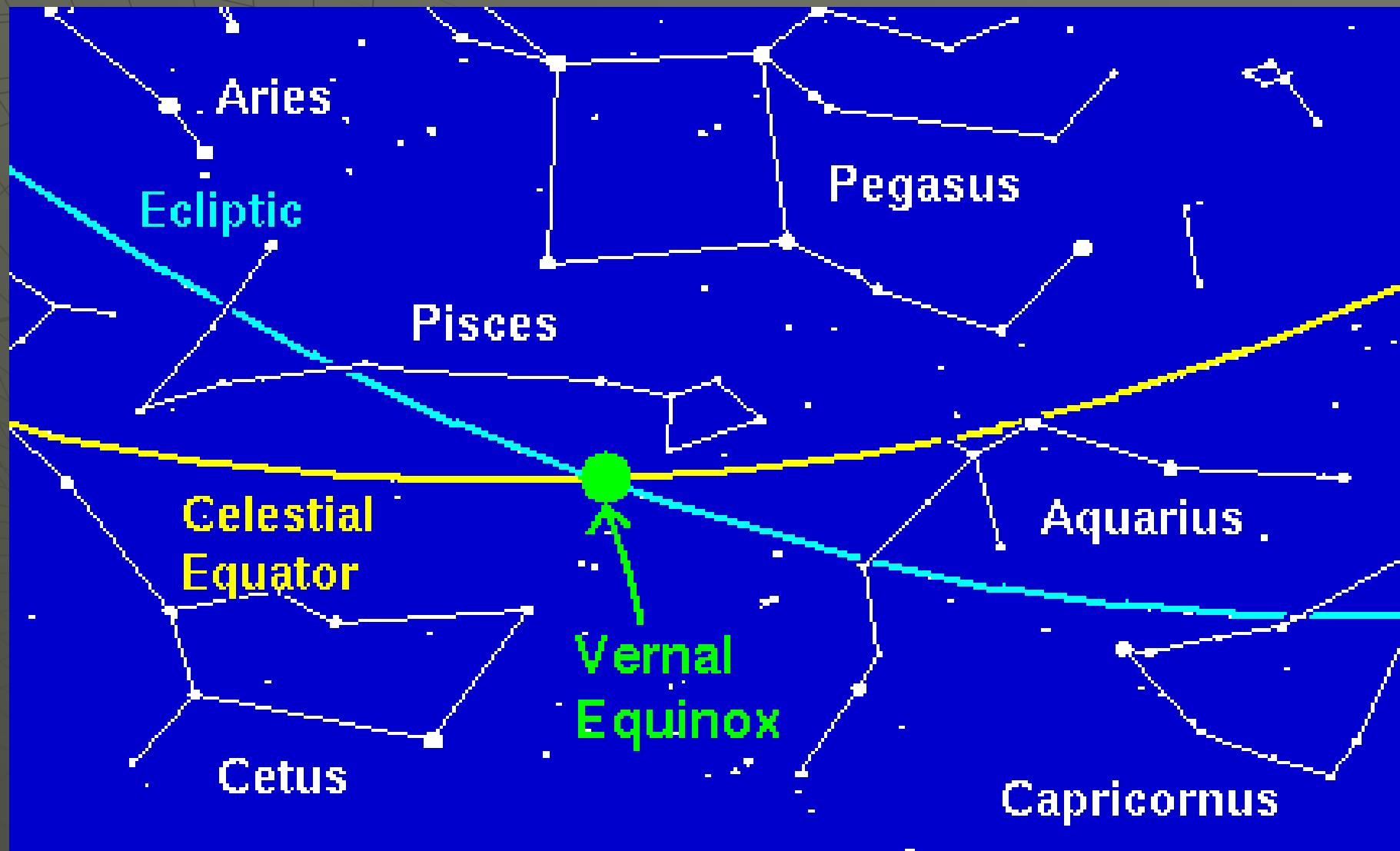
- ◆ Sidereal Day: 1 rotation with respect to the stars → 23:56
- ◆ Solar Day: 1 rotation with respect to the sun → 24:00
- ◆ Point 1: The sun and a distant star are both on the observer's meridian.
- ◆ Point 2: The same star reaches the meridian (sidereal day)
- ◆ Point 3: The sun has again returned to meridian (solar day)
- ◆ It takes an extra four minutes to go from Point 2 to 3.



Sidereal Year

- As you may have guessed, a sidereal year is how long it takes Earth to complete one orbit exactly, with respect to the stars.
- 1 sidereal year = 365d 6h 9m 10s \approx 365.25 days
- A tropical year is the time it takes for the Sun to go from vernal equinox and back (ecliptic crosses the equator)
- 1 tropical year = 365d 5h 48m 46s \approx 365.24 days
 - We use the tropical year
- Gregorian calendar: includes leap years to account for that ~ 0.25 days

Why does the Sun Shift to Different Constellations???



Precession

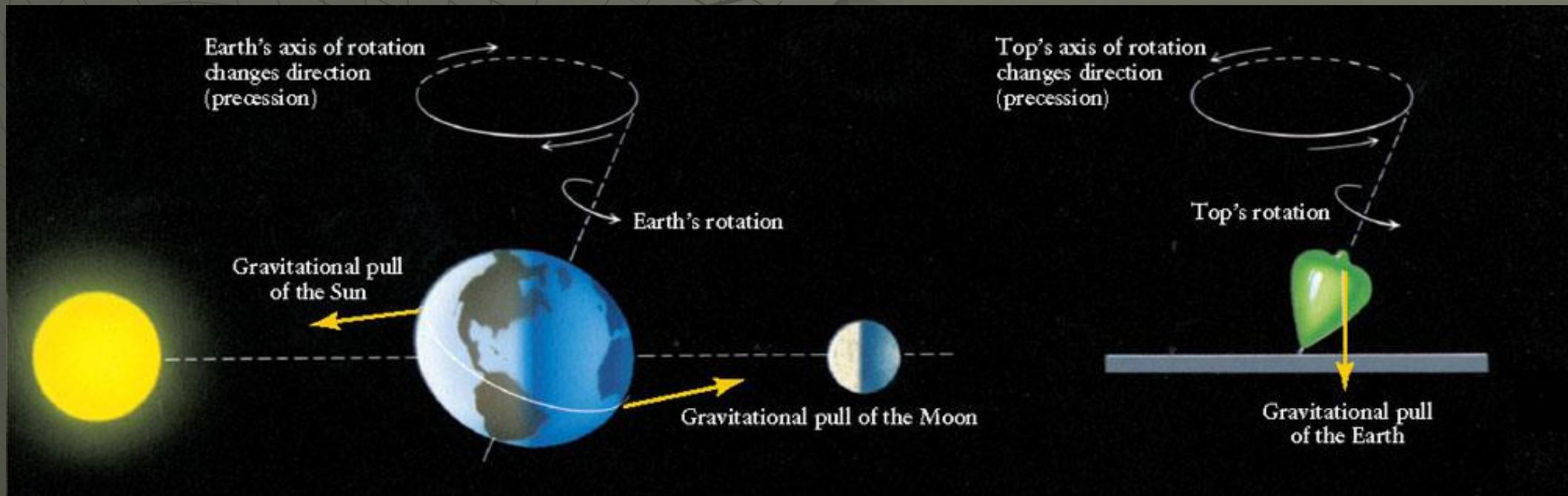
- 1 sidereal year = 365d 6h 9m 10s
 - 1 tropical year = 365d 5h 48m 46s
-

20 mins 24 sec

- ◆ The intersection of the Ecliptic-Equator is moving with respect to the stars!

Precession

Because the Earth is rotating and being pulled by gravity (Sun and Moon), the direction of its axis precesses, like a spinning top



Precession

One cycle takes 26,000 years



LT

- ◆ Siderial Day
 - Pg 11

- ◆ How will the Sun's position in the sky at noon change if you travel 20° south?
 - A. The Sun's altitude will decrease by 20°
 - B. The Sun's altitude will increase by 20°

- ◆ During the summer solstice in Laramie, WY at noon, the Sun will be:
 - A. At zenith
 - B. In the southern sky
 - C. In the Northern sky
 - D. Not visible

◆ At what latitude will the Sun cross the zenith on an equinox?

- A. 41
- B. 0
- C. 23.5
- D. 90