

TODAY

- APPEARANCE OF THE SKY

- ORIENTATION

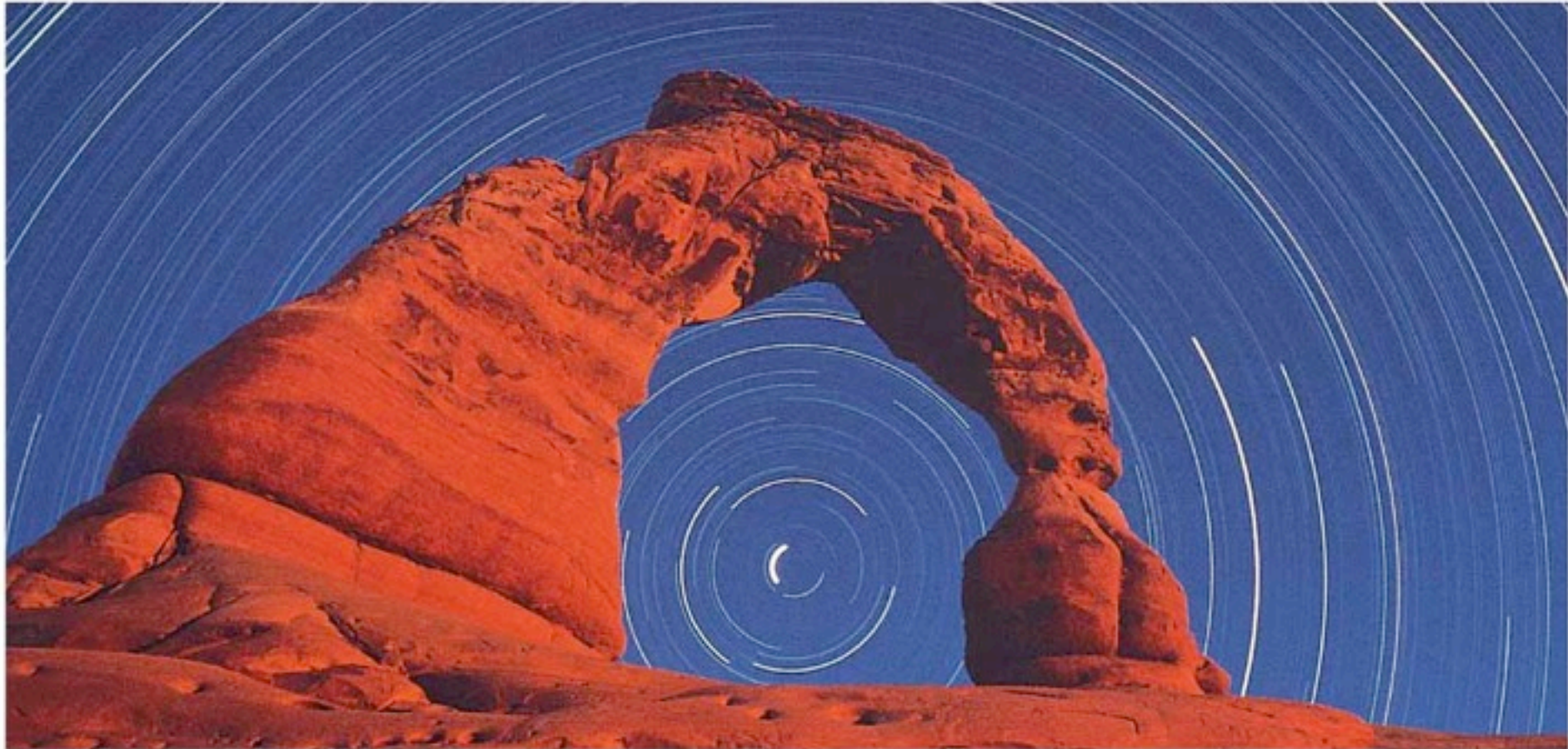
- MOTION OF SKY

- SEASONS

- PRECESSION

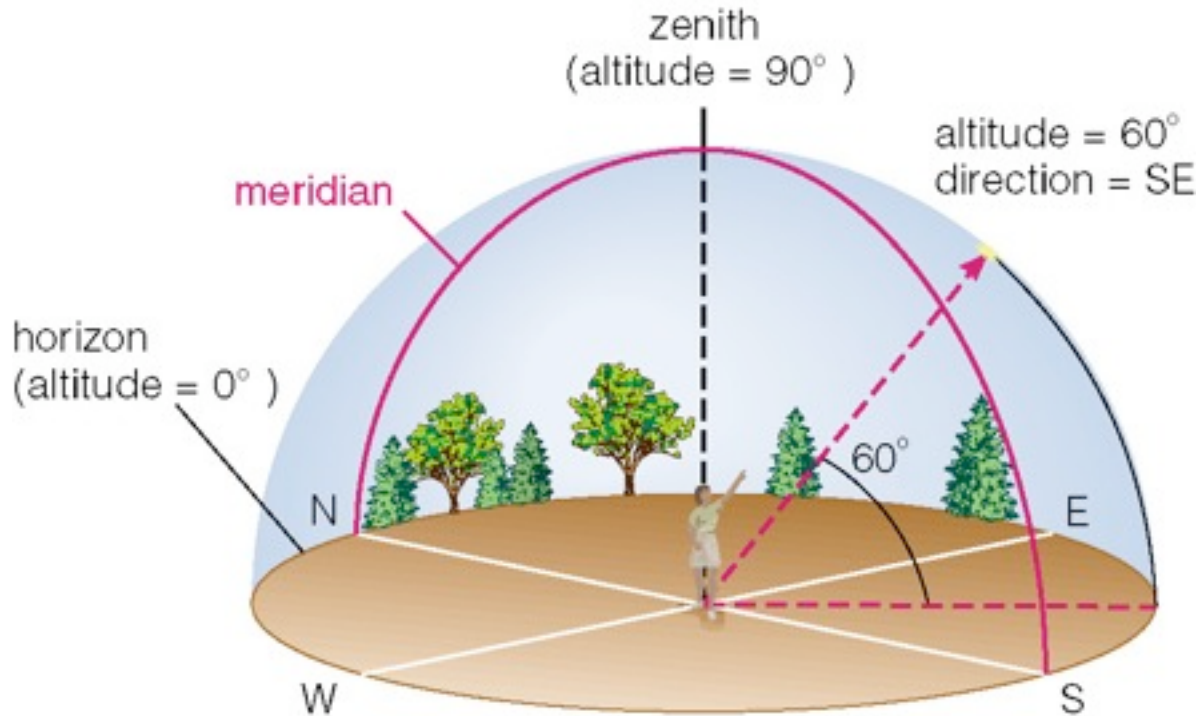
- PHASES OF THE MOON

The Appearance of the Sky

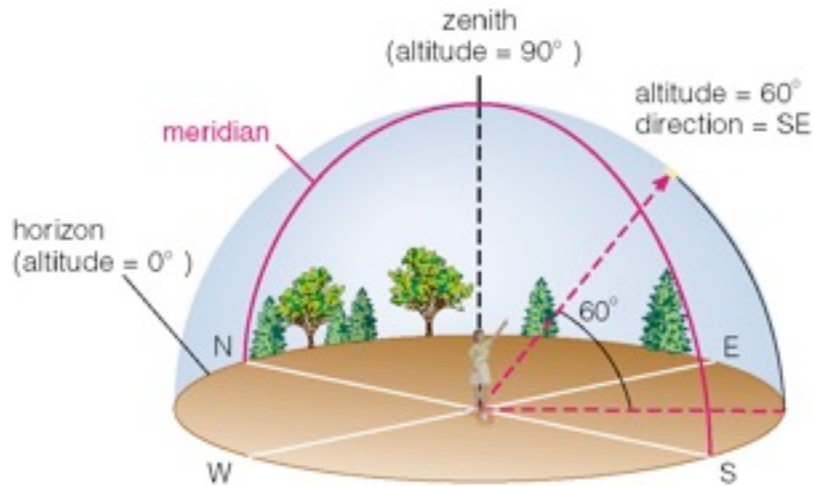


The Local Sky

An object's **altitude** (above horizon) and **direction** (along horizon) specify its location in your local sky.



The Local Sky

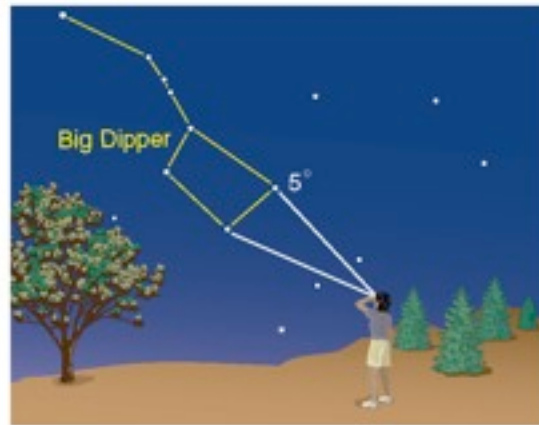
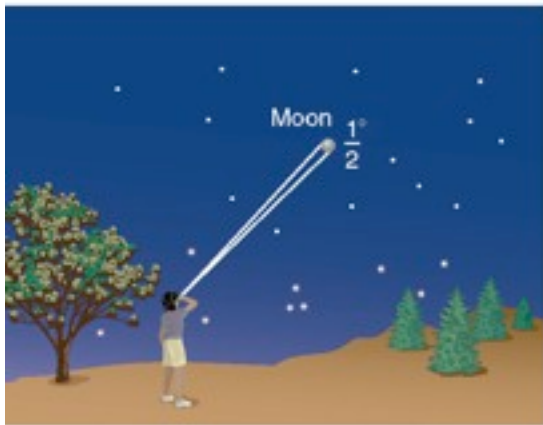


Zenith: The point directly overhead

Horizon: All points 90° away from zenith

Meridian: Line passing through zenith and connecting N and S points on the horizon

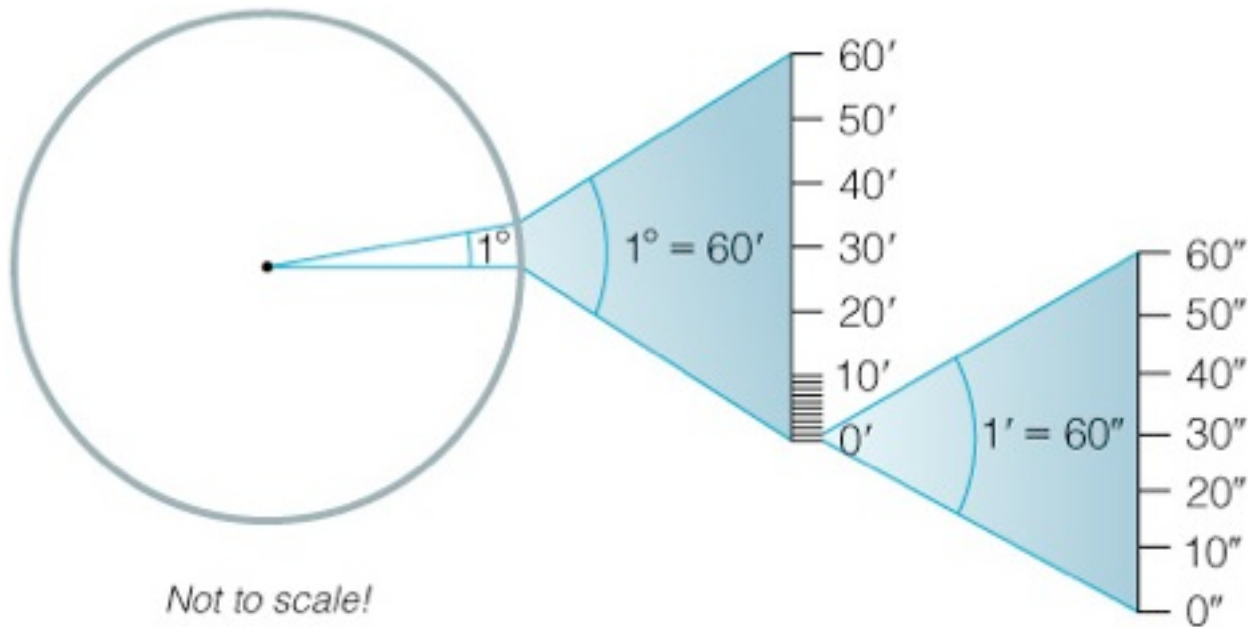
We measure the sky using *angles*



Stretch out your arm as shown here.

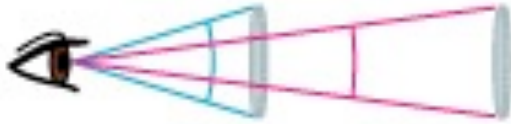
Angular Measurements

- Full circle = 360°
- $1^\circ = 60'$ (arcminutes)
- $1' = 60''$ (arcseconds)

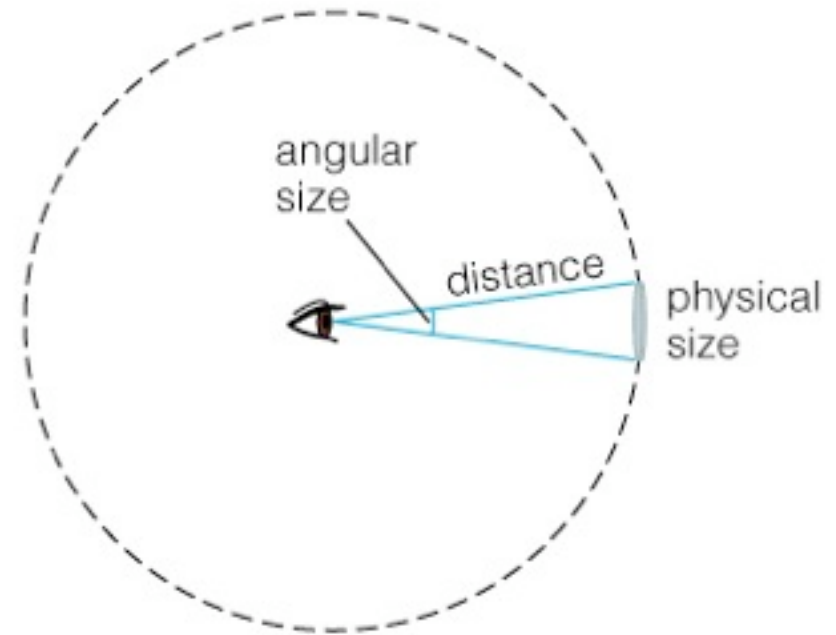


Angular Size

$$\text{angular size} = \text{physical size} \times \frac{360 \text{ degrees}}{2\pi \times \text{distance}}$$



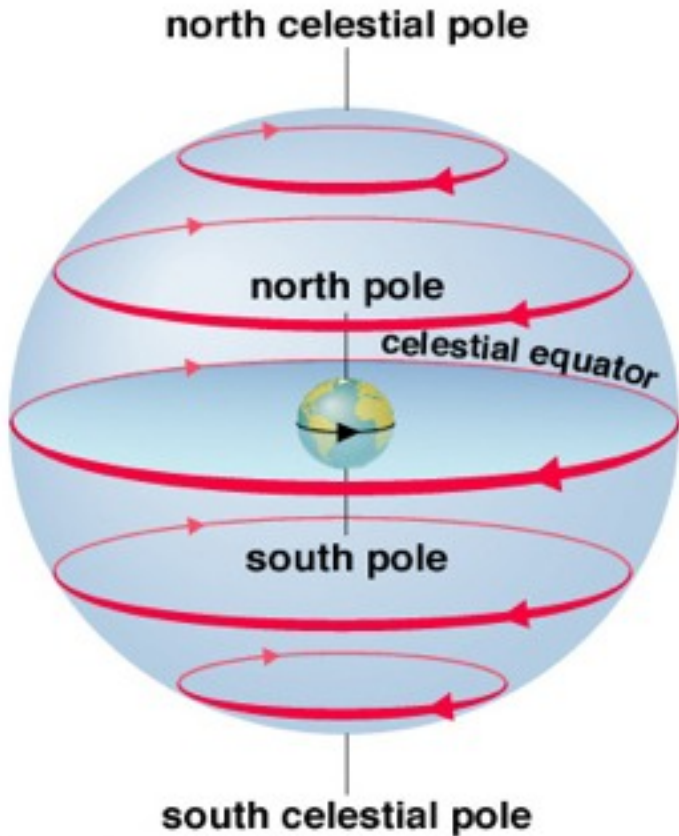
An object's angular size appears smaller if it is farther away.



$$\theta = L/D$$

$$\text{angular size (in radians)} = \frac{\text{physical size}}{\text{distance}}$$

Why do stars rise and set?



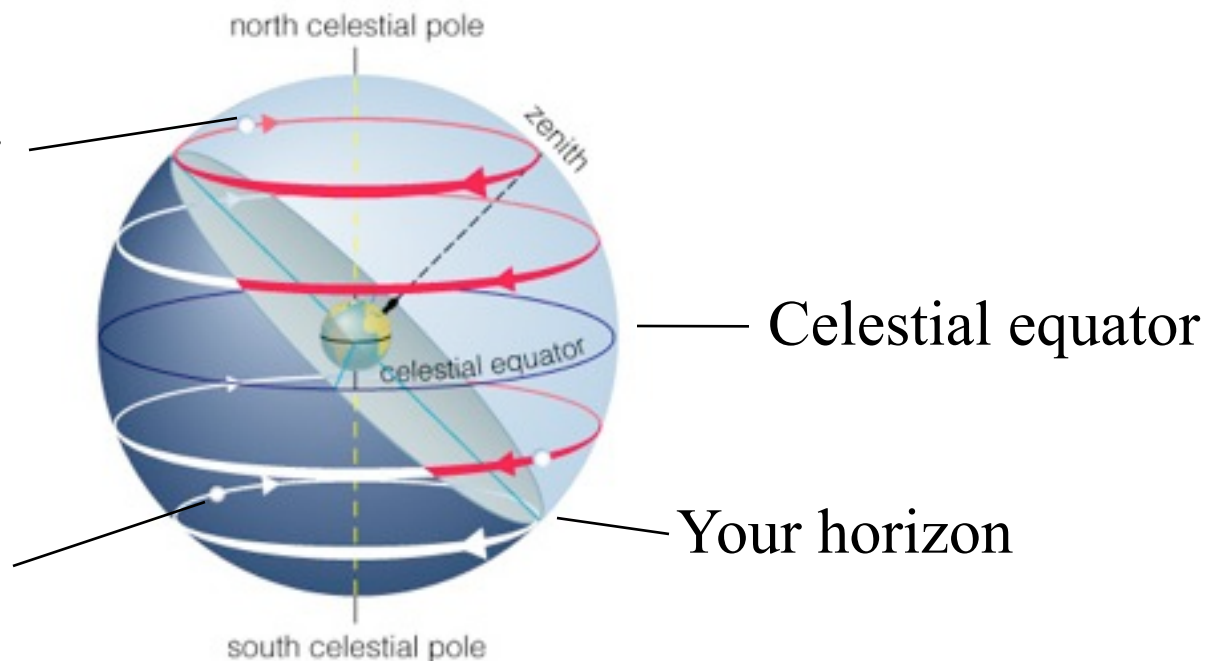
Earth rotates west to east, so stars appear to circle from east to west.

Our view from Earth:

- Stars near the north celestial pole are circumpolar and never set.
- We cannot see stars near the south celestial pole.
- All other stars (and Sun, Moon, planets) rise in east and set in west.

A circumpolar star never sets

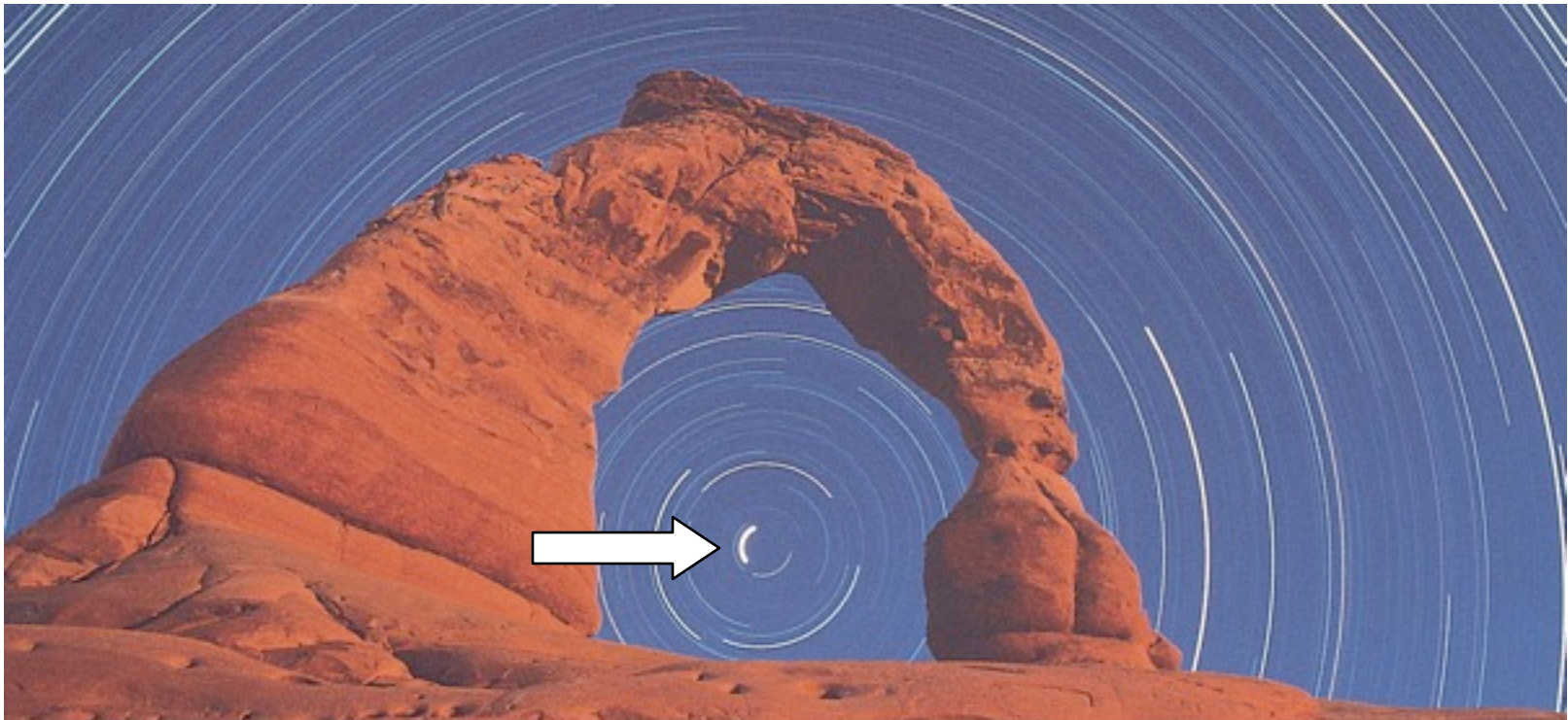
This star never rises



Thought Question

What is the arrow pointing to?

The North Star

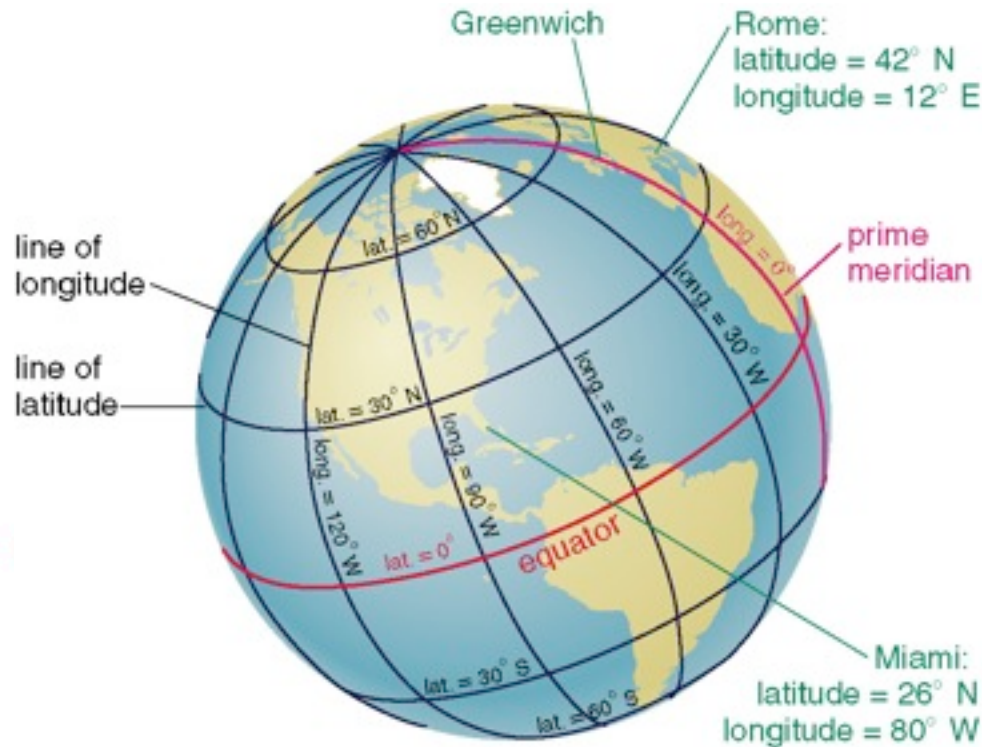


Why do the constellations we see depend on latitude and time of year?

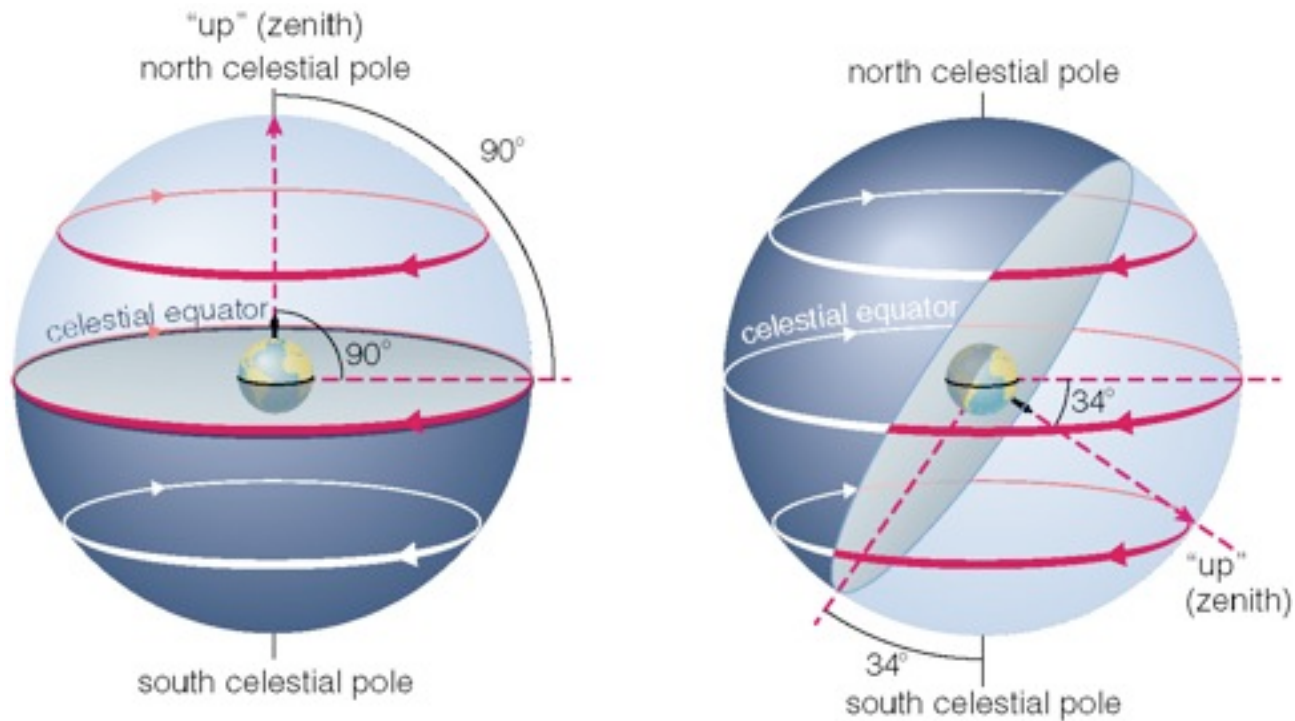
- They depend on latitude because your position on Earth determines which constellations remain below the horizon.
- They depend on time of year because Earth's orbit changes the apparent location of the Sun among the stars.

Review: Coordinates on the Earth

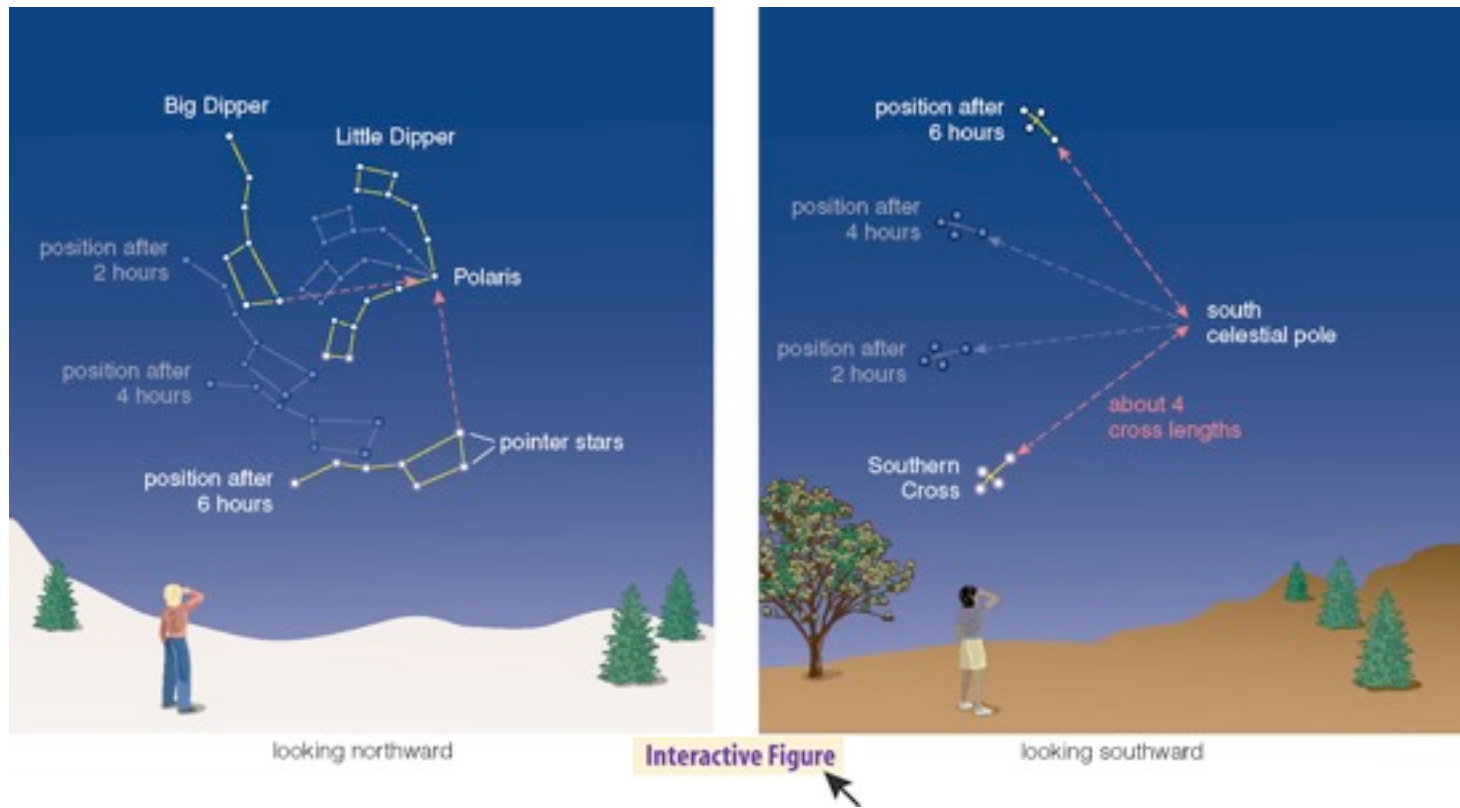
- **Latitude:** position north or south of equator
- **Longitude:** position east or west of prime meridian (runs through Greenwich, England)



The sky varies with latitude but not longitude.

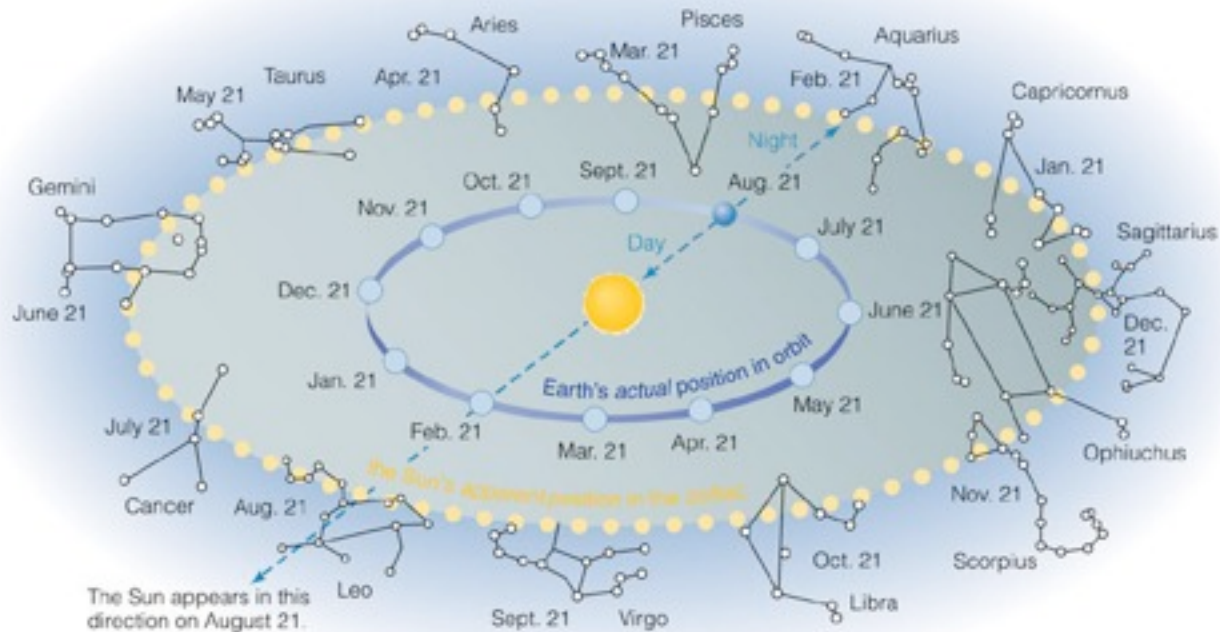


Altitude of the celestial pole = your latitude



The sky varies as Earth orbits the Sun

- As the Earth orbits the Sun, the Sun appears to move eastward along the ecliptic.
- At midnight, the stars on our meridian are opposite the Sun in the sky.

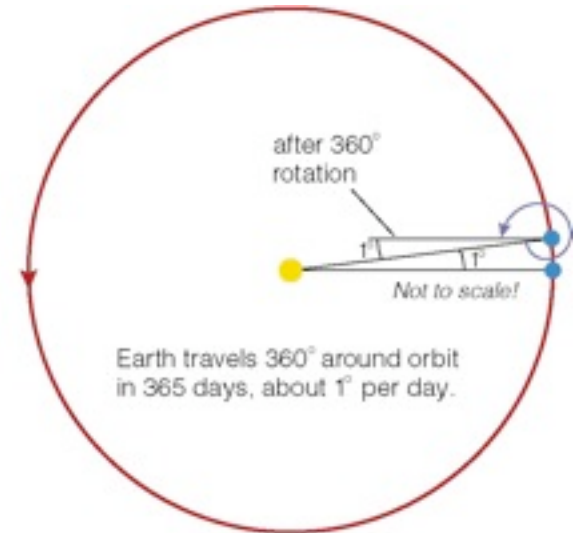
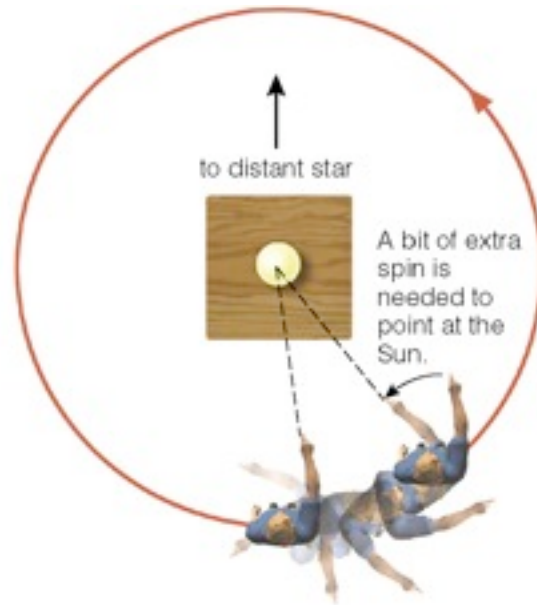


Solar & Sidereal Day

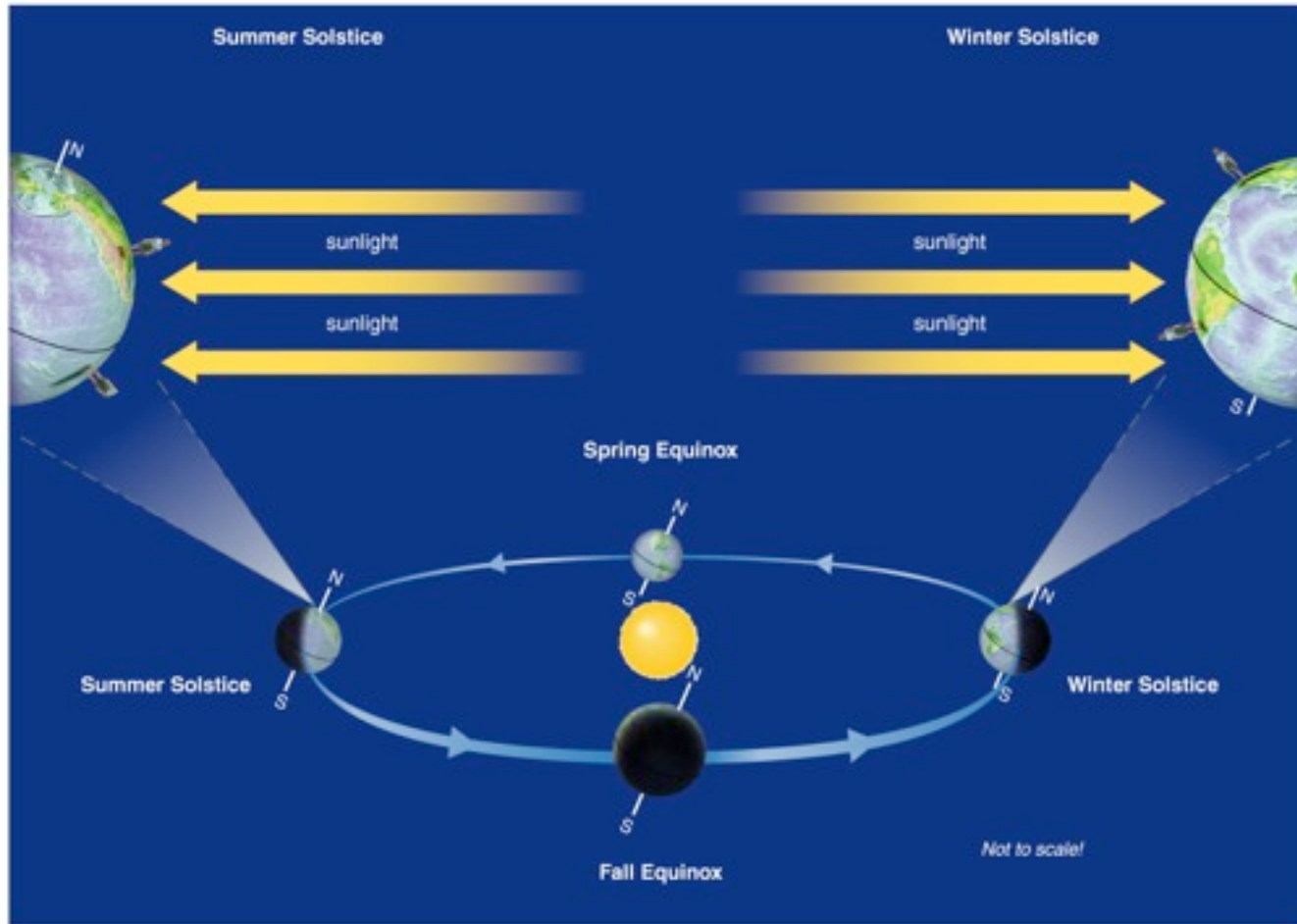
- **Solar** day = 24:00 hours (noon to noon)
 - combination of Earth's spin
 - plus Earth's orbital motion
- **Sidereal** day (Earth's spin period) = 23:56
 - time between meridian crossings of one star



One full rotation means you are again pointing in the same direction.

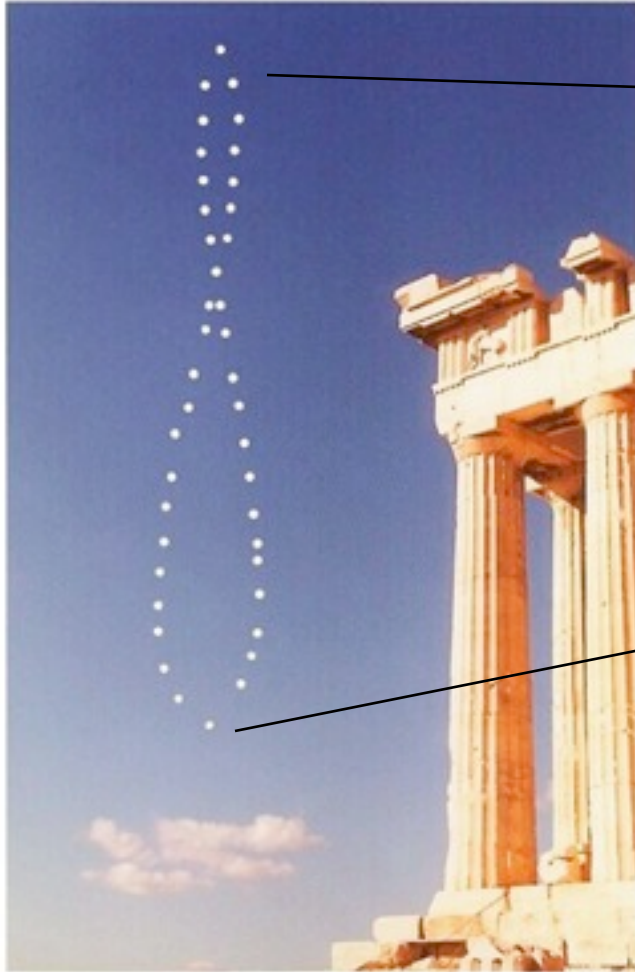


What causes the seasons?



Seasons depend on how Earth's axis affects the directness of sunlight.

Sun's altitude also changes with seasons



Sun's position at noon in summer: higher altitude means more direct sunlight.

Sun's position at noon in winter: lower altitude means less direct sunlight.

Summary: The Reason for Seasons

- Earth's axis points in the same direction (to Polaris) all year round, so its orientation *relative to the Sun* changes as Earth orbits the Sun.
- Summer occurs in your hemisphere when sunlight hits it more directly; winter occurs when the sunlight is less direct.
- **AXIS TILT** is the key to the seasons; without it, we would not have seasons on Earth.
- **DISTANCE** from the sun matters relatively little because the Earth's orbit is *nearly* circular. The variation of the Earth-Sun distance is only about 3%.