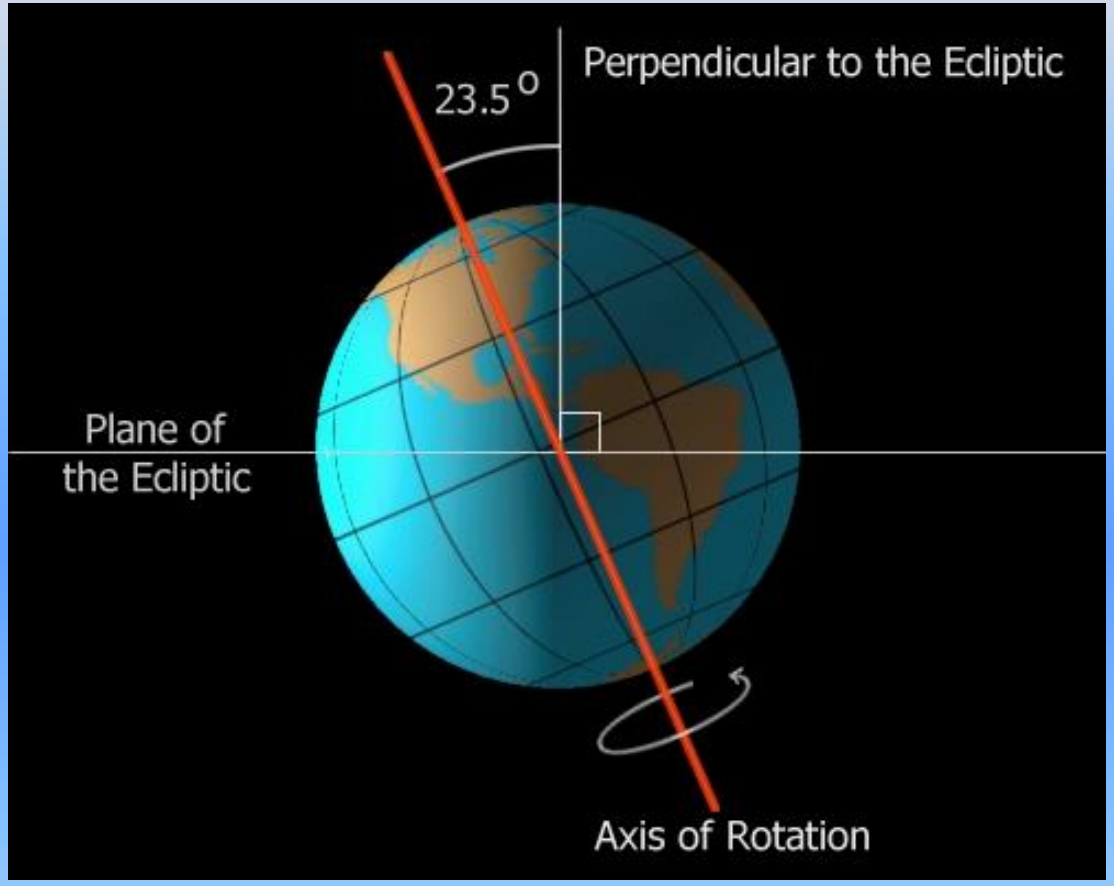
IV. Earth Motions: Rotation vs. Revolution

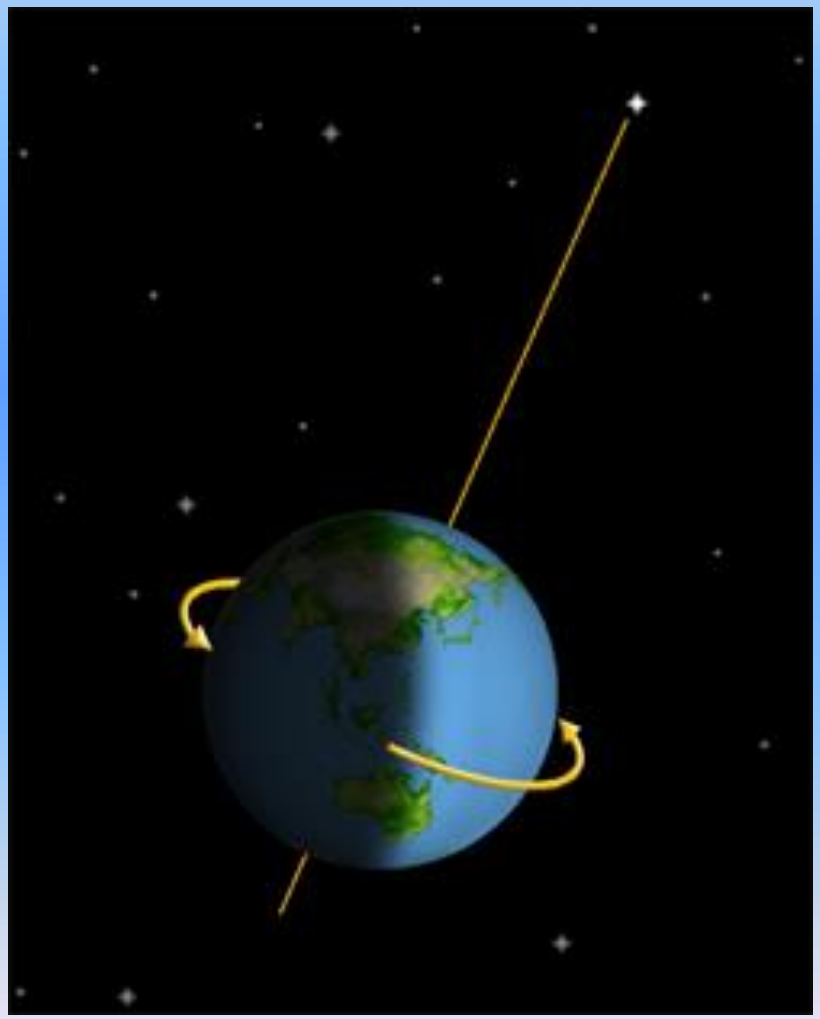
A. Rotation



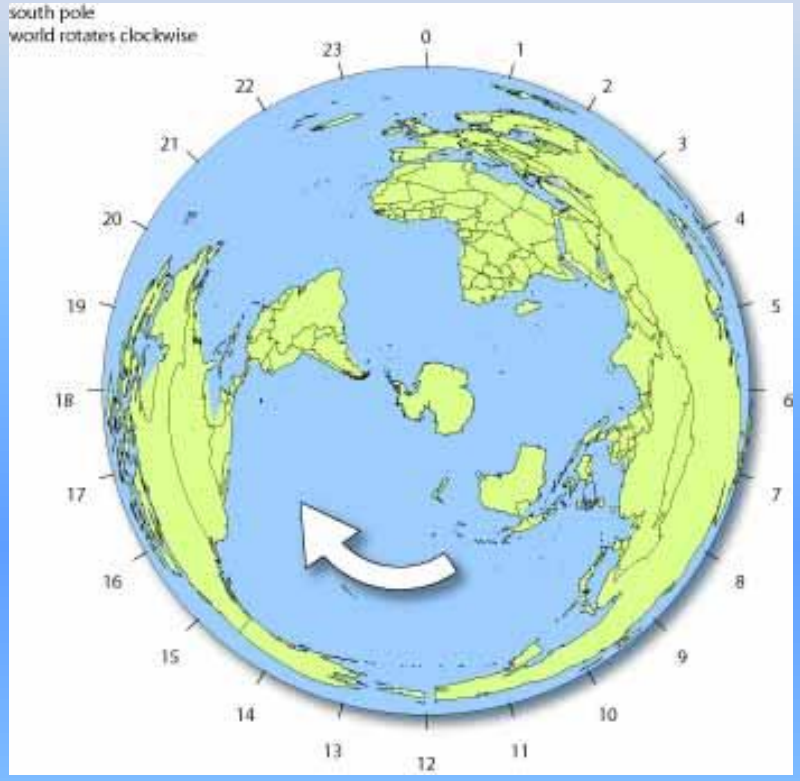
1. Earth spins on it's __axis____, the imaginary straight line through Earth between the North Pole and the South Pole
2. The axis of rotation is ____inclined____ 23 ½ degrees from a perpendicular to the plane of Earth's orbit.

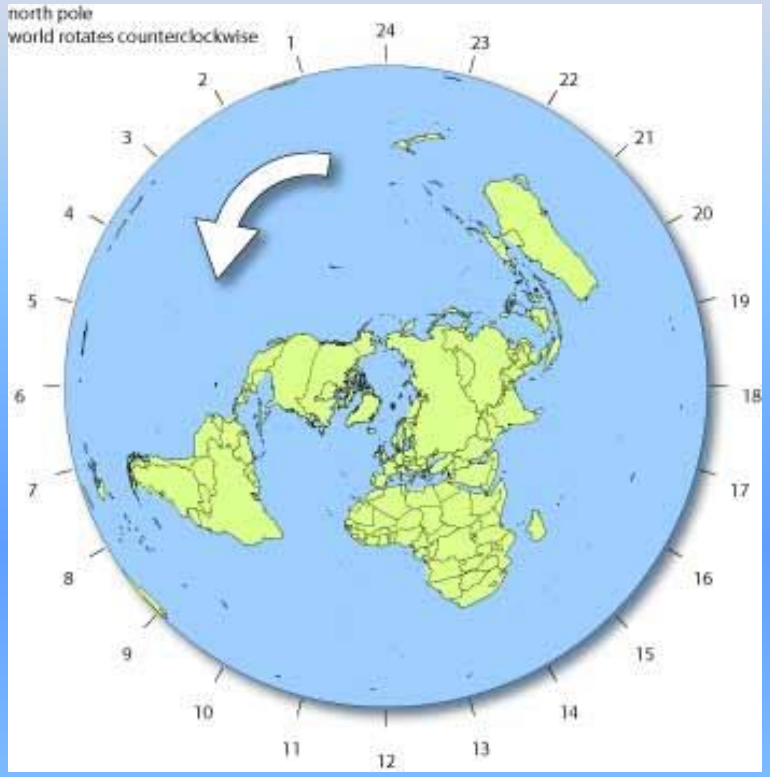
3. The north axis always stays aimed towards the North Star (_____).

Polaris



4. Rate of Earth's Rotation





a. Earth makes one complete turn from _____ to _____ every _____.

west

east

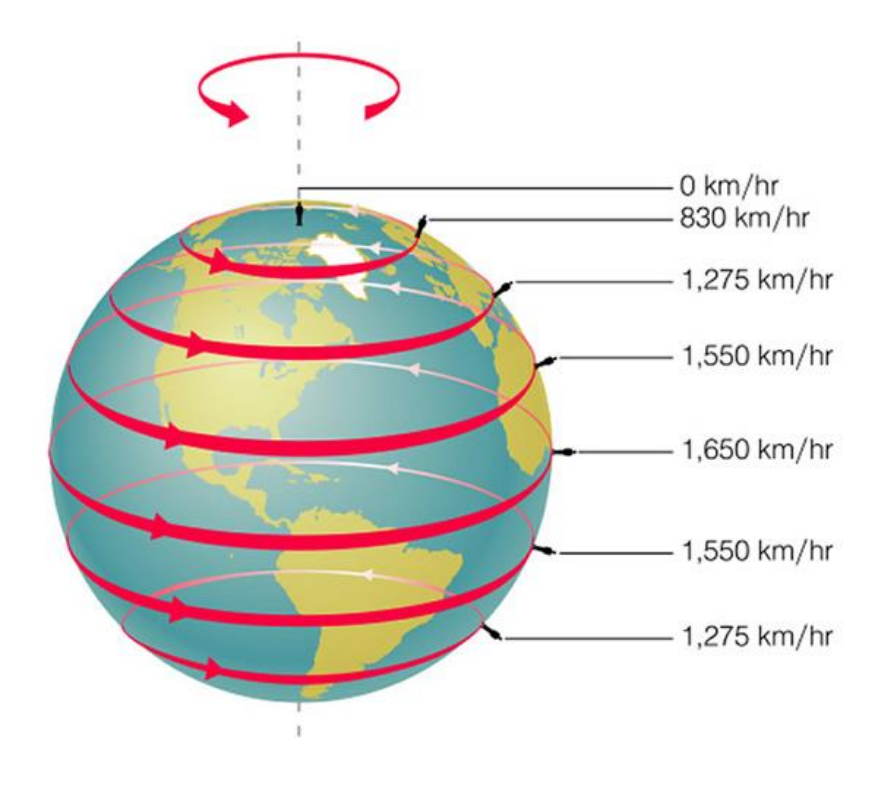
24 hours

b. Angular Rate of Rotation: One complete rotation is equal to _____ degrees in 24 hours or _____.

360

15°/hr

c. Linear Rate of Rotation



(1) Speed changes with latitude north or south of the equator.
(2) The greater the latitude, the slower the speed.
(3) At the equator the speed is 1,000 miles/hour or 1,650 km/hour.

5. Evidence of Earth's Rotation

a. The Foucault Pendulum (pronounced foo-koe)

- Jean-Bernard Foucault
- Suspended a 28 kg mass from a wire 67 m long from the dome of the *Pantheon* in Paris
- 1851

(1) Once set in motion, a free-swinging pendulum will continue to swing along the same path unless acted upon by an outside force due to ~~inertia~~.

(2) In 1851Jean Bernard Leon Foucault performed his third demonstration using the principal of a pendulum to prove that Earth rotates.

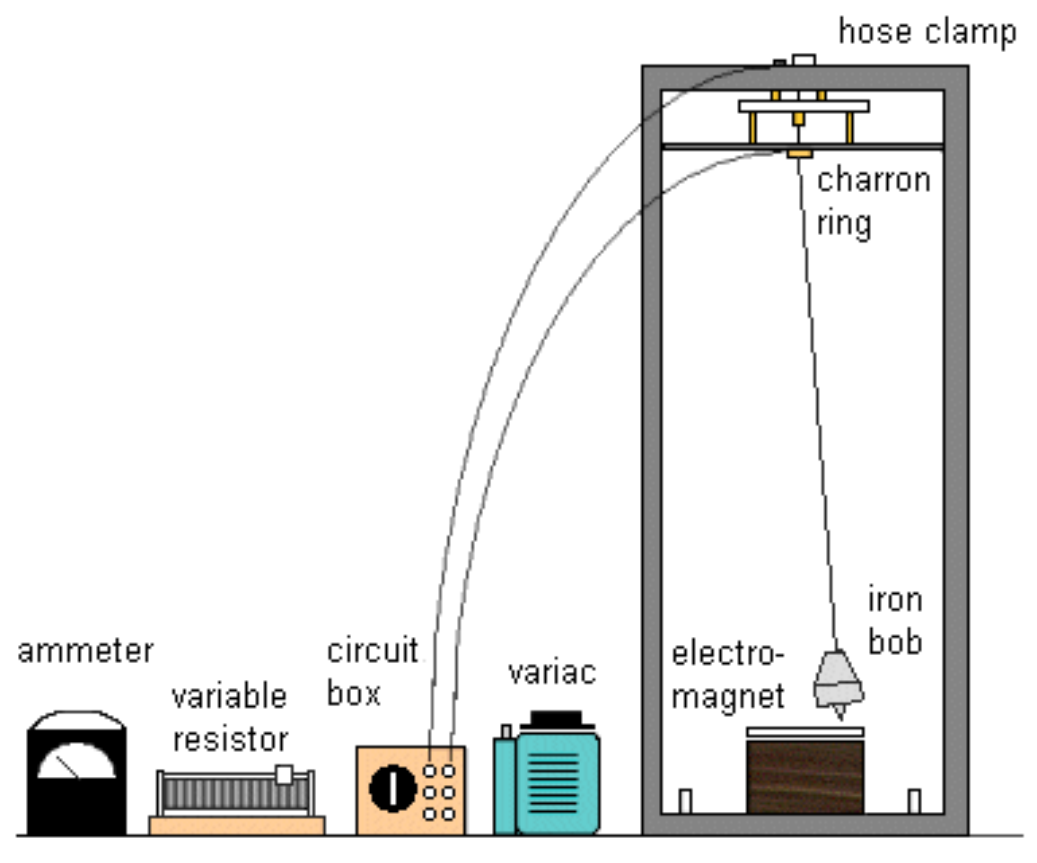
(3) A steel wire 220 feet long heavy weight (bob) of lead in copper at its end was suspended from the Pantheon in Paris.

(a) After a period of time it *appeared* that the direction of the pendulum's path had changed but no outside force had affected it.

(b) He concluded that it was Earth that had rotated under the pendulum and not the pendulum that had turned.

Foucault Pendulum

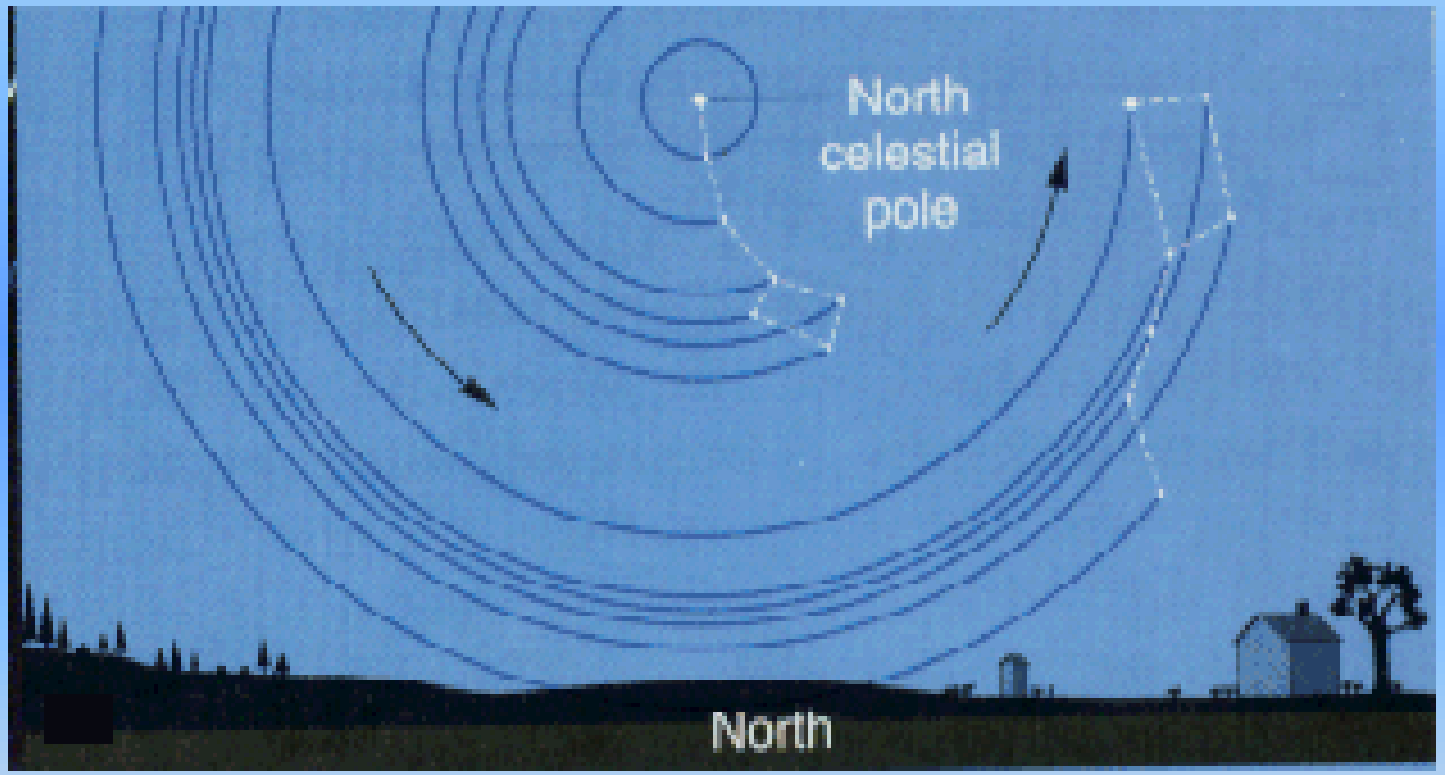
Foucault Pendulum



Foucault Pendulum

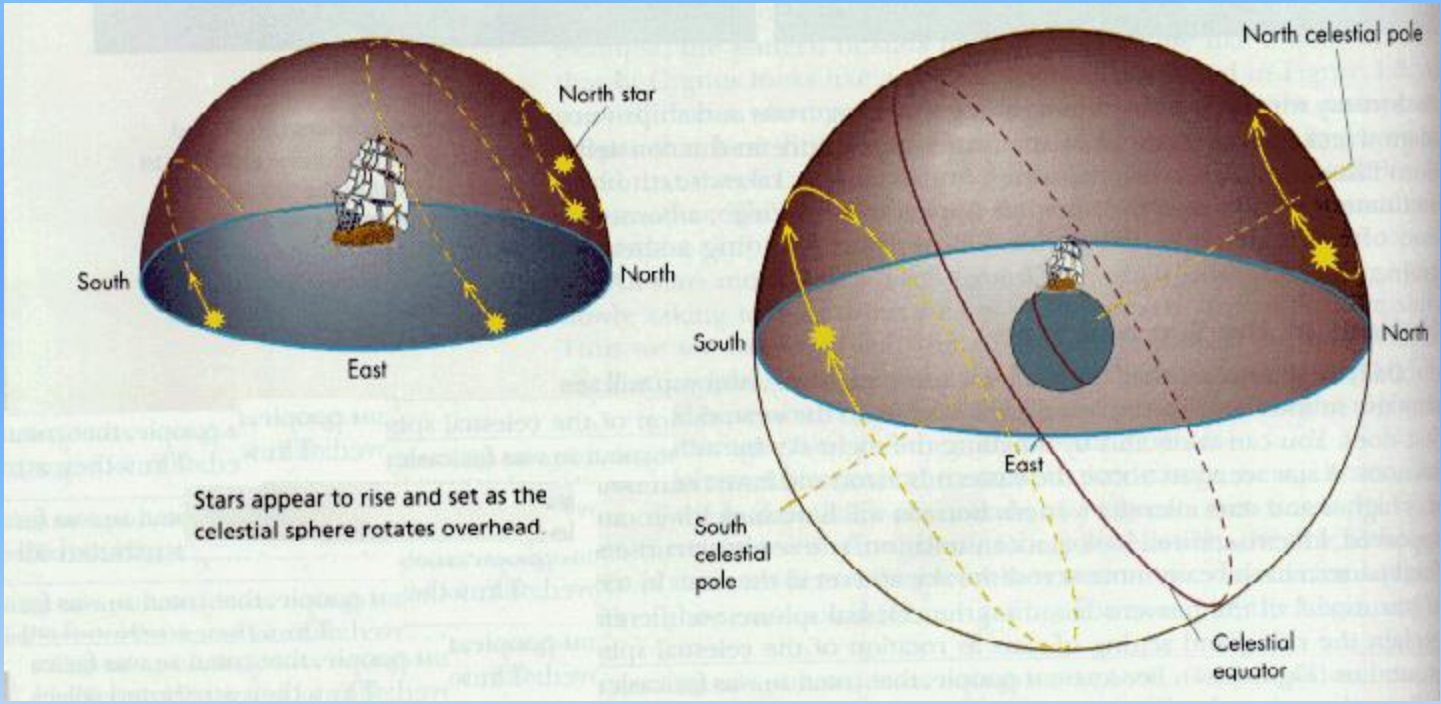
b. Apparent Motion of Celestial Objects

(1) Circumpolar Motion of Stars in the North Sky



Stars appear to move around Polaris
in a counterclockwise direction each night

(2) In the southern sky, the sun, the moon, stars, and planets appear to move in arcs from east to west



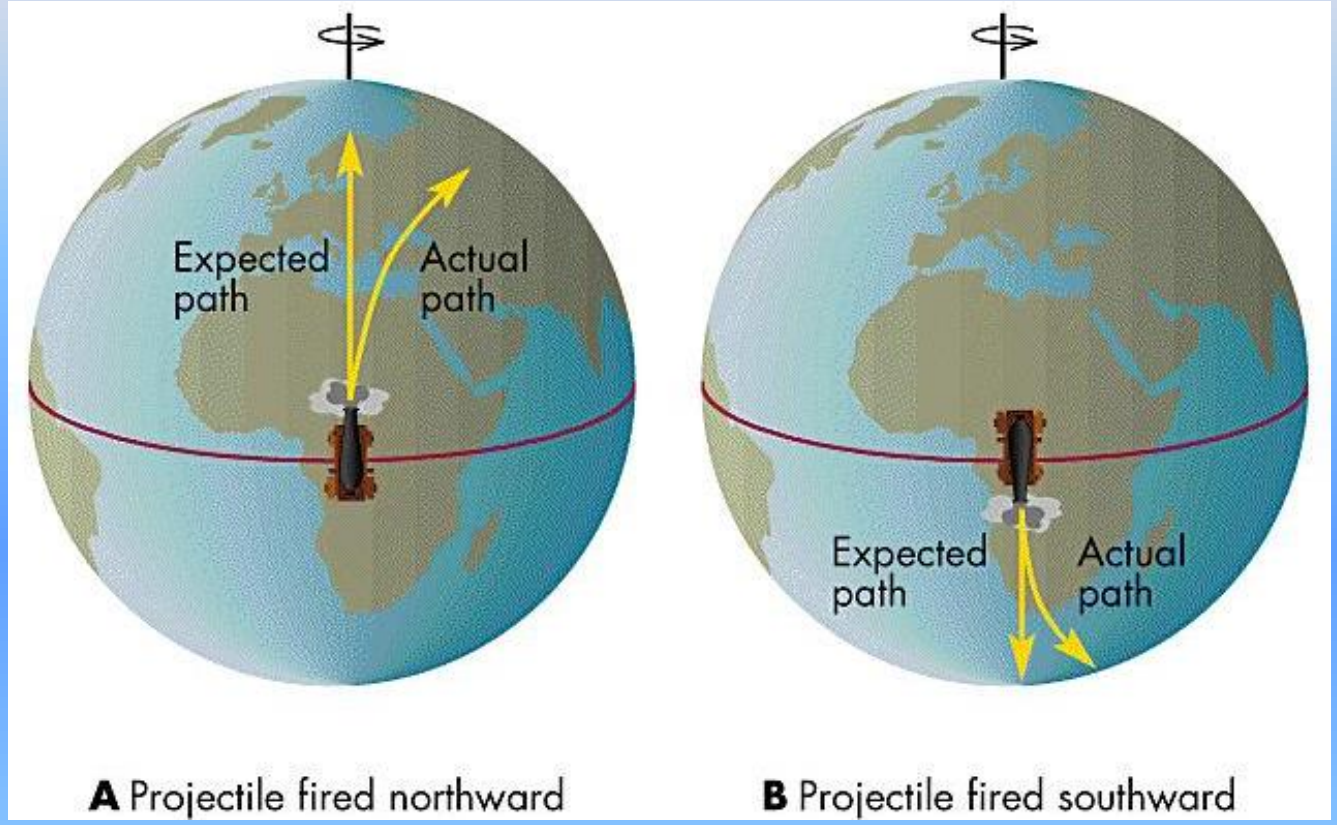
(3) Star Trails

When photographs of stars are taken in the night sky using long-term exposures they appear as streaks of light rather than points of light.

The Northern Sky

Star Trails

4. The Coriolis Effect



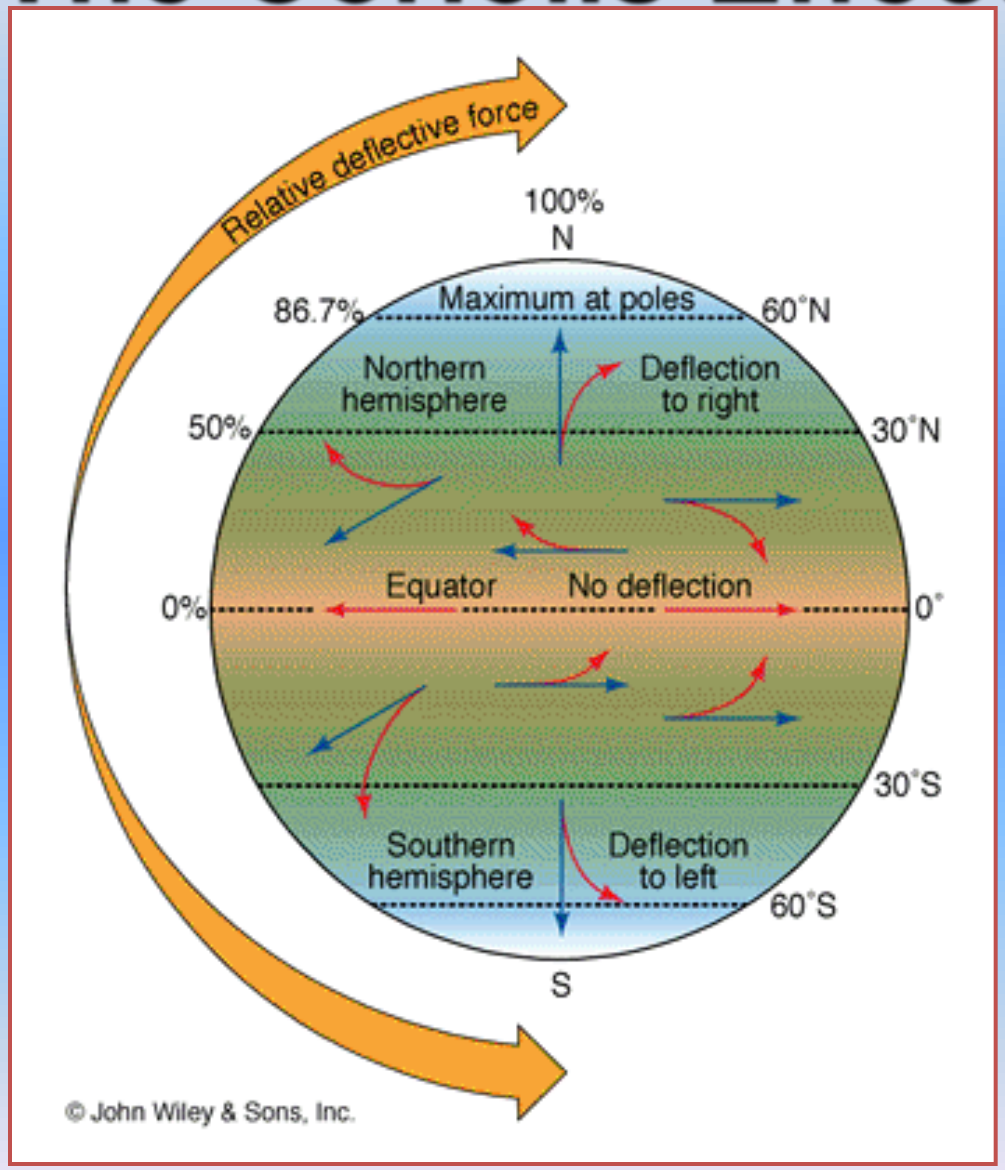
(a) Objects moving over Earth's surface appears to be deflected from a straight path and curve.

(b) This is due to the fact that Earth rotates at different speeds at different latitudes.

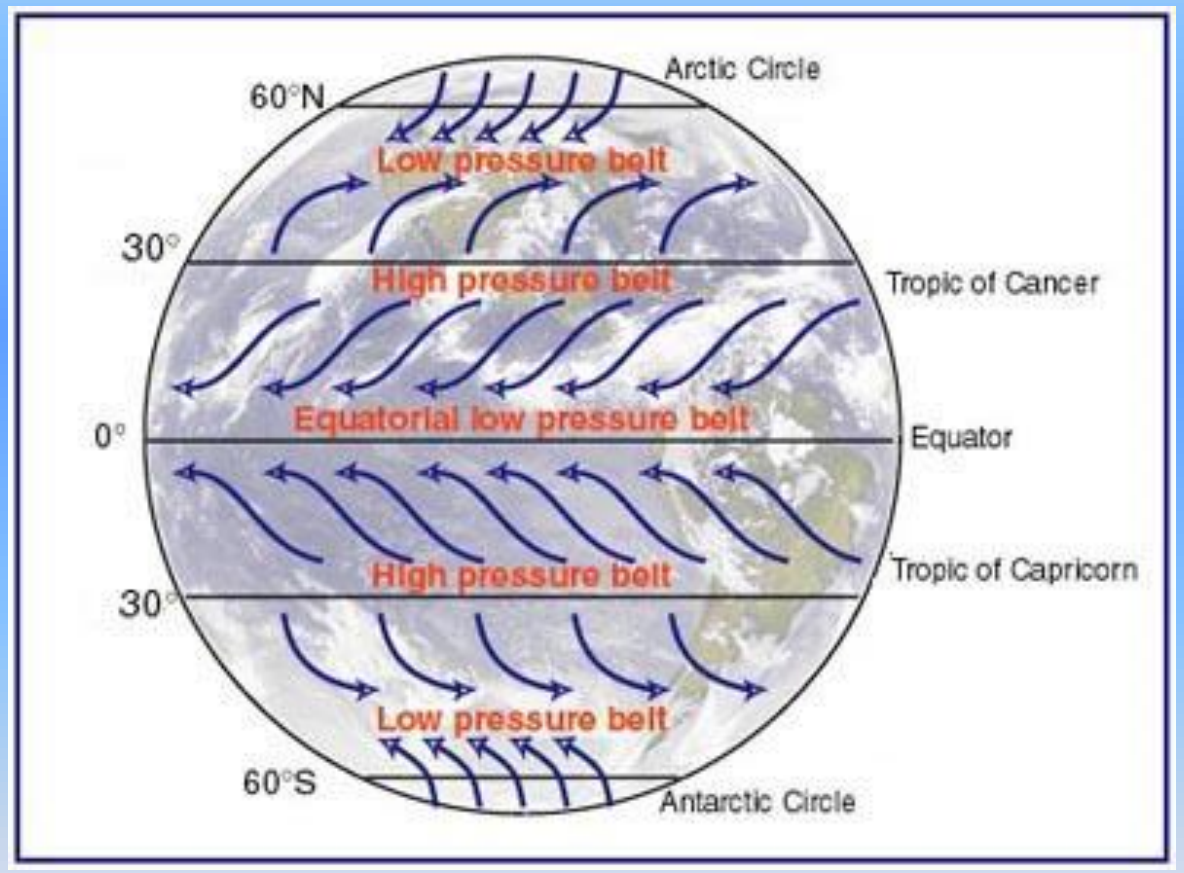
(c) North Hemisphere deflection: To the right of the direction of travel

(d) Southern Hemisphere deflection: To the left of the direction of travel

The Coriolis Effect

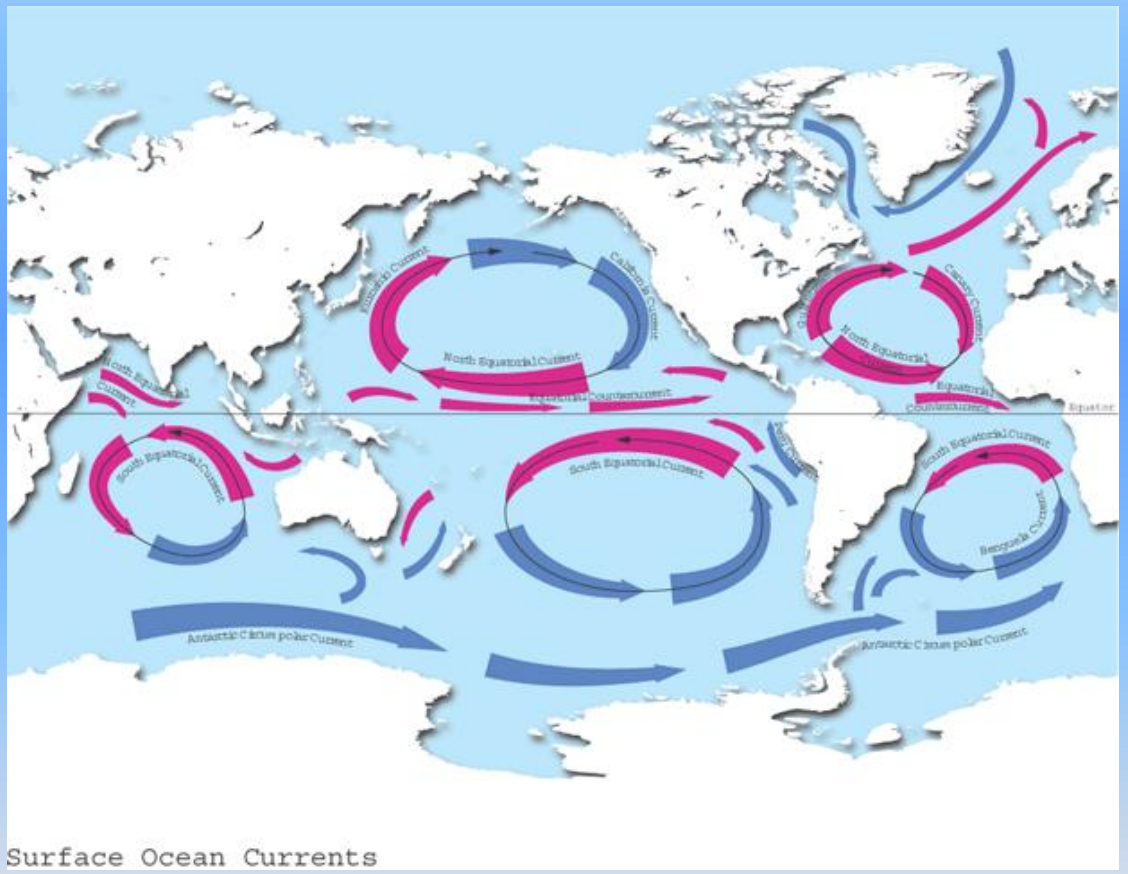


The Coriolis Effect- Curved Planetary Winds



The Coriolis Effect- Spiral Winds in Storms

The Coriolis Effect- Curved Ocean Currents



Surface Ocean Currents

e. **The Coriolis Effect is responsible for the curved path of:**

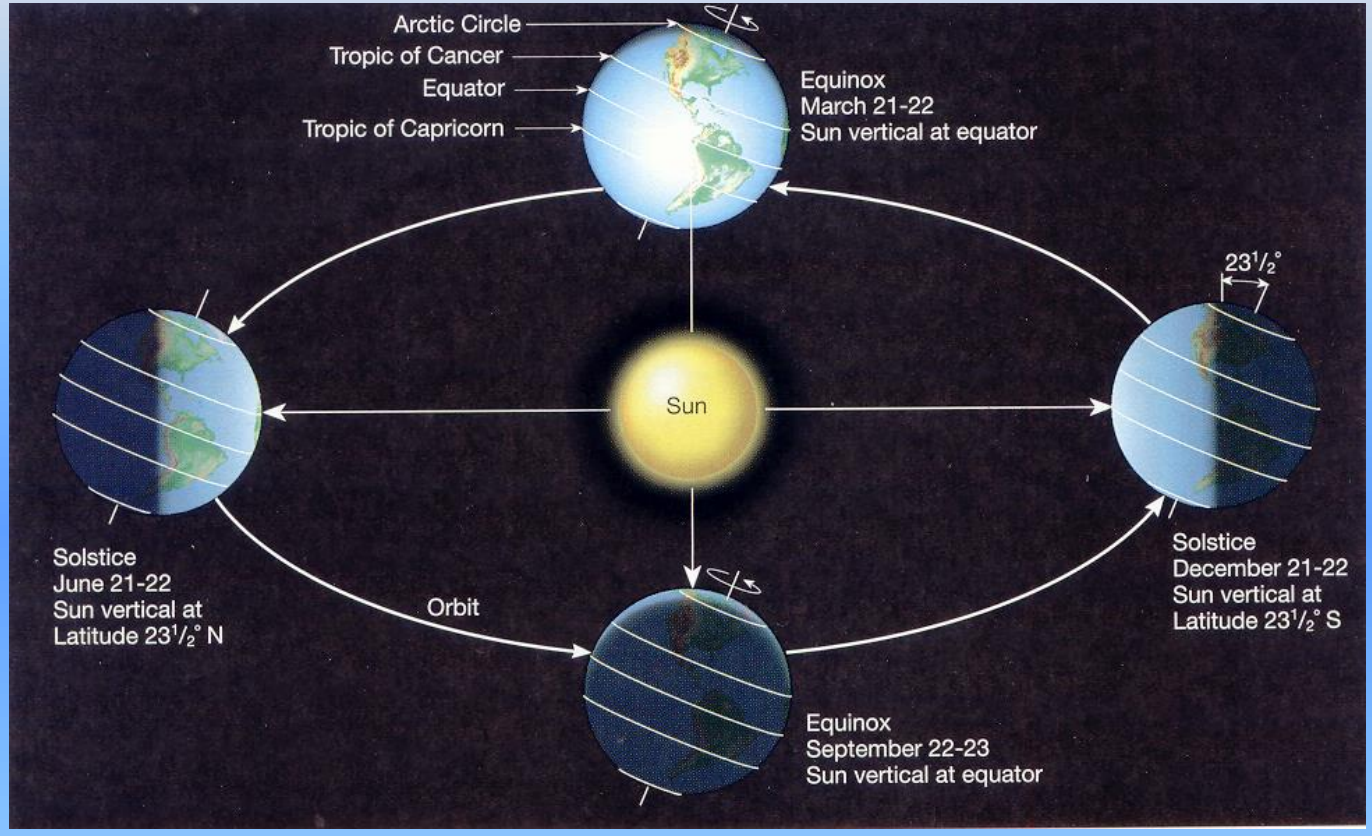
- **Planetary Winds**
- **Winds in Storms (vorticity)**
- **Ocean Currents**

f. Observations from Space

Earth's rotation has been seen by astronauts and recorded by satellites.

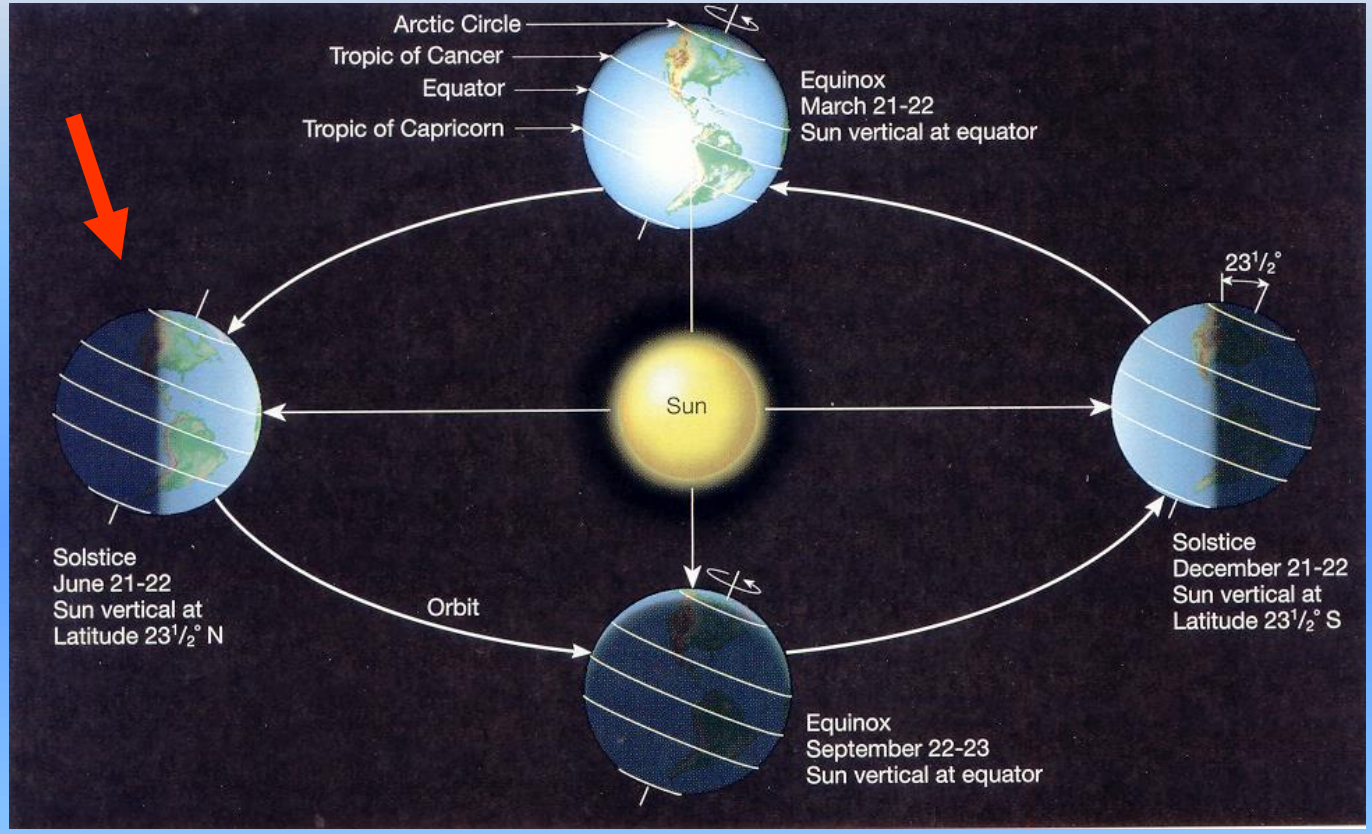
The spacecraft Galileo took this picture of the Earth and Moon from space as it headed out to its encounter with the planet Jupiter. The photo was taken from a distance of about 6.2 million km from Earth.

B. Revolution



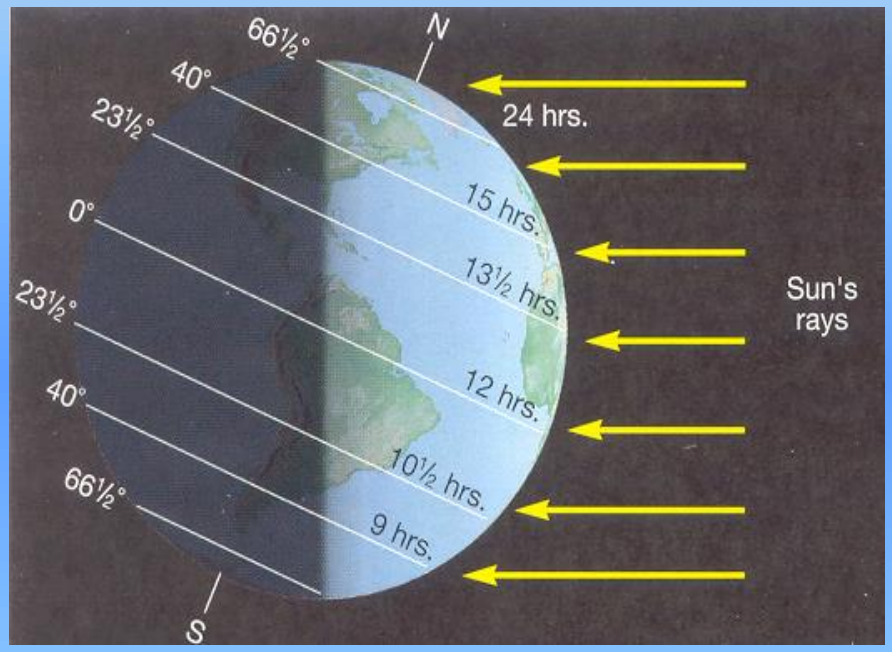
1. Revolution is the motion of Earth traveling around the Sun in it's orbit .
2. Parallelism of Earth's axis: The position of Earth's axis is parallel to every other position of the axis.
   a. This is the cause of seasons on Earth.

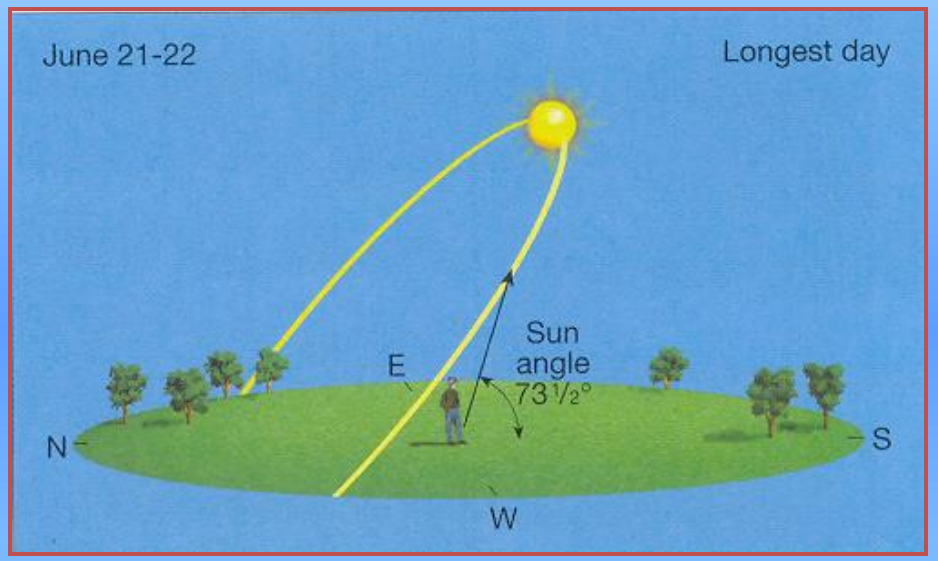
B. Revolution



b. Summer: When the hemisphere "leans" towards the sun.

Northern Hemisphere Summer Solstice



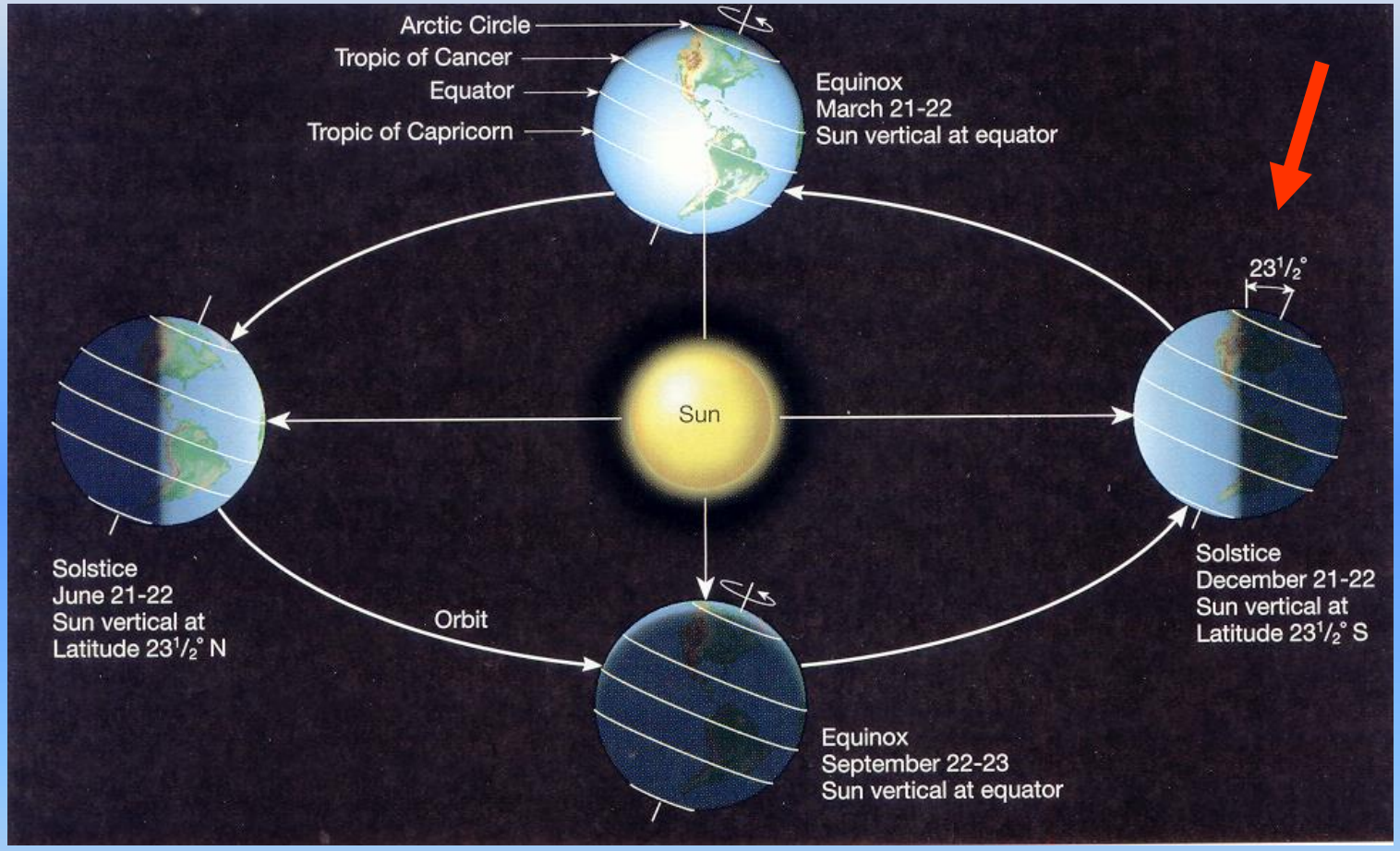


(1) The apparent path of the sun is the __longest__.

(2) The sun reaches it's __highest__ altitude for the year.

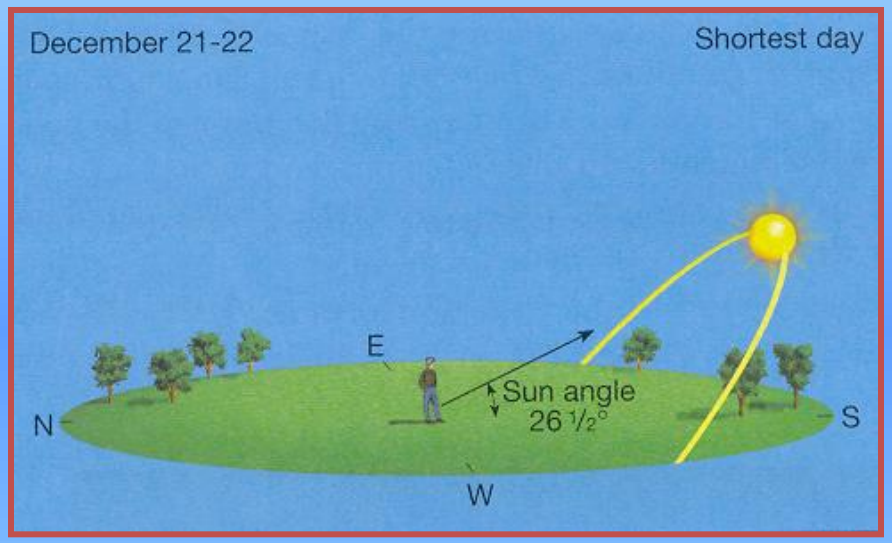
(3) __Longest__ period of daylight.

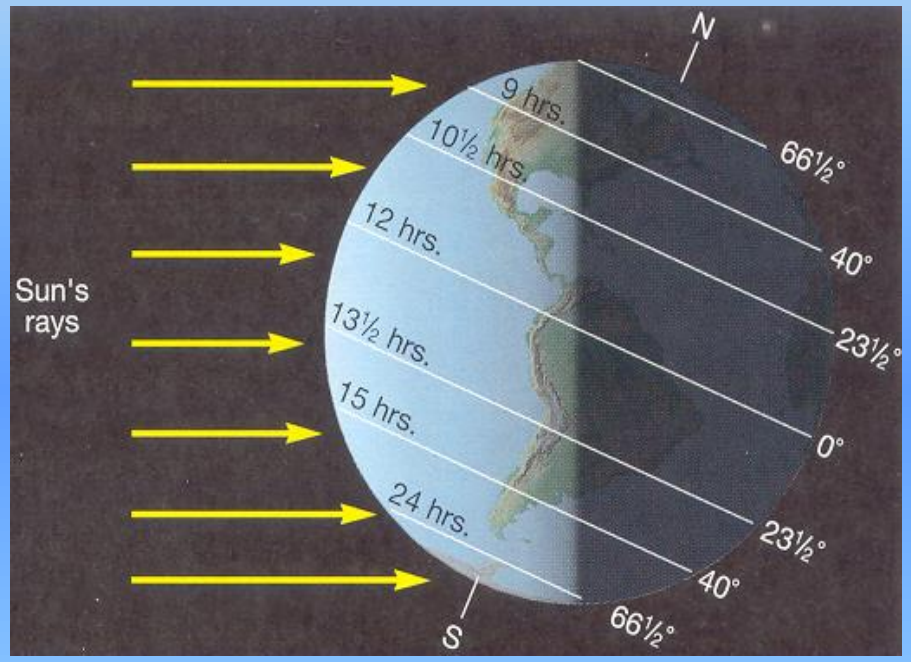
B. Revolution



c. Winter: When the hemisphere "leans" away from the sun.

Northern Hemisphere Winter Solstice





(1) The apparent path of the sun is the shortest.

(2) The sun reaches it's lowest altitude for the year.

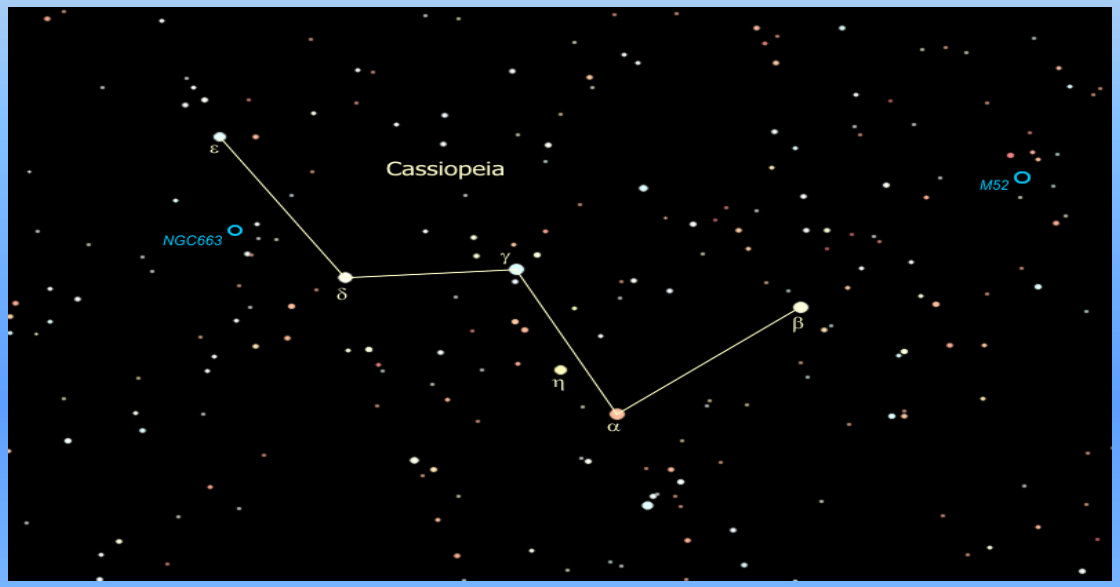
(3) Shortest period of daylight.

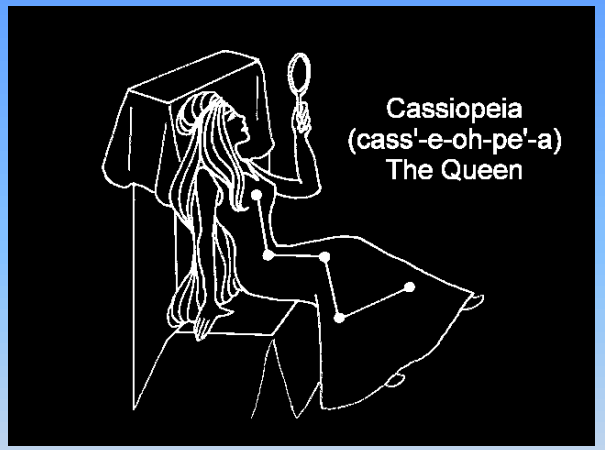
3. Seasonal Change in Constellations

a. **Constellations** are groups of stars appearing to form **pictures**.

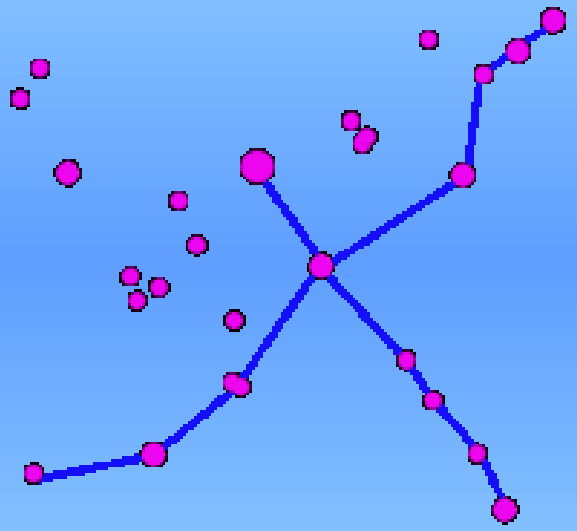
Imaginary groupings of stars invented by ancient civilizations, poets, farmers, and astronomers

Cassiopeia


Cassiopeia
ε
δ
γ
β
η
α
NGC663
M52

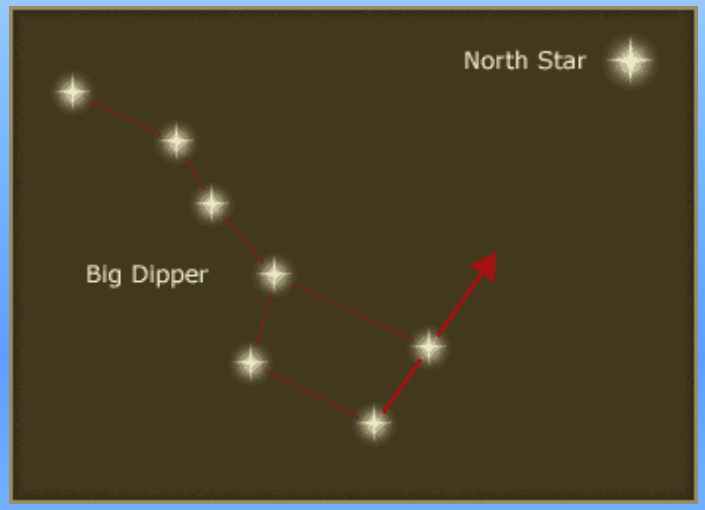

Cassiopeia
(cass'-e-oh-pe'-a)
The Queen

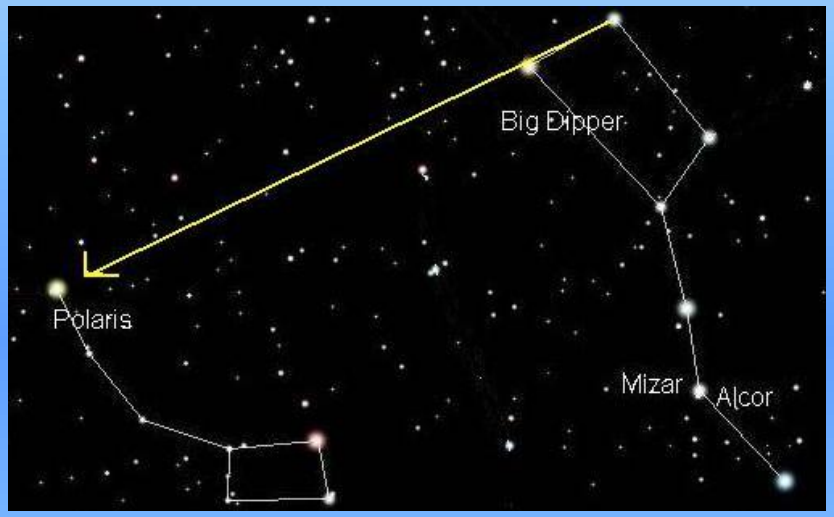
Cygnus



Orion

The Big Dipper – Ursa Minor





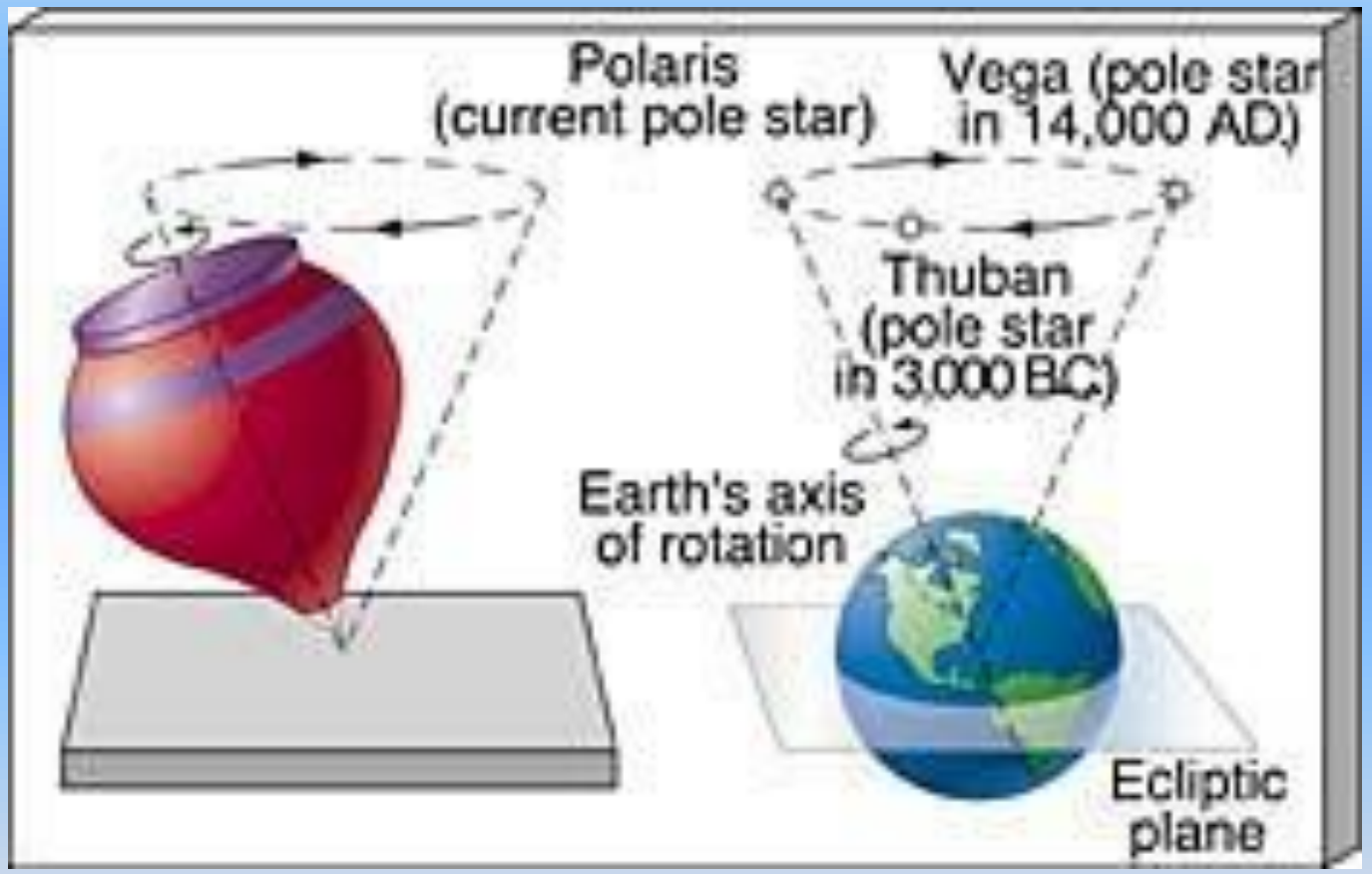
- Use the “Pointer Stars” to find Polaris (the North Star) in the evening sky

Finding Polaris Using the Big Dipper

Polaris Will Not Be the North Star in the Future

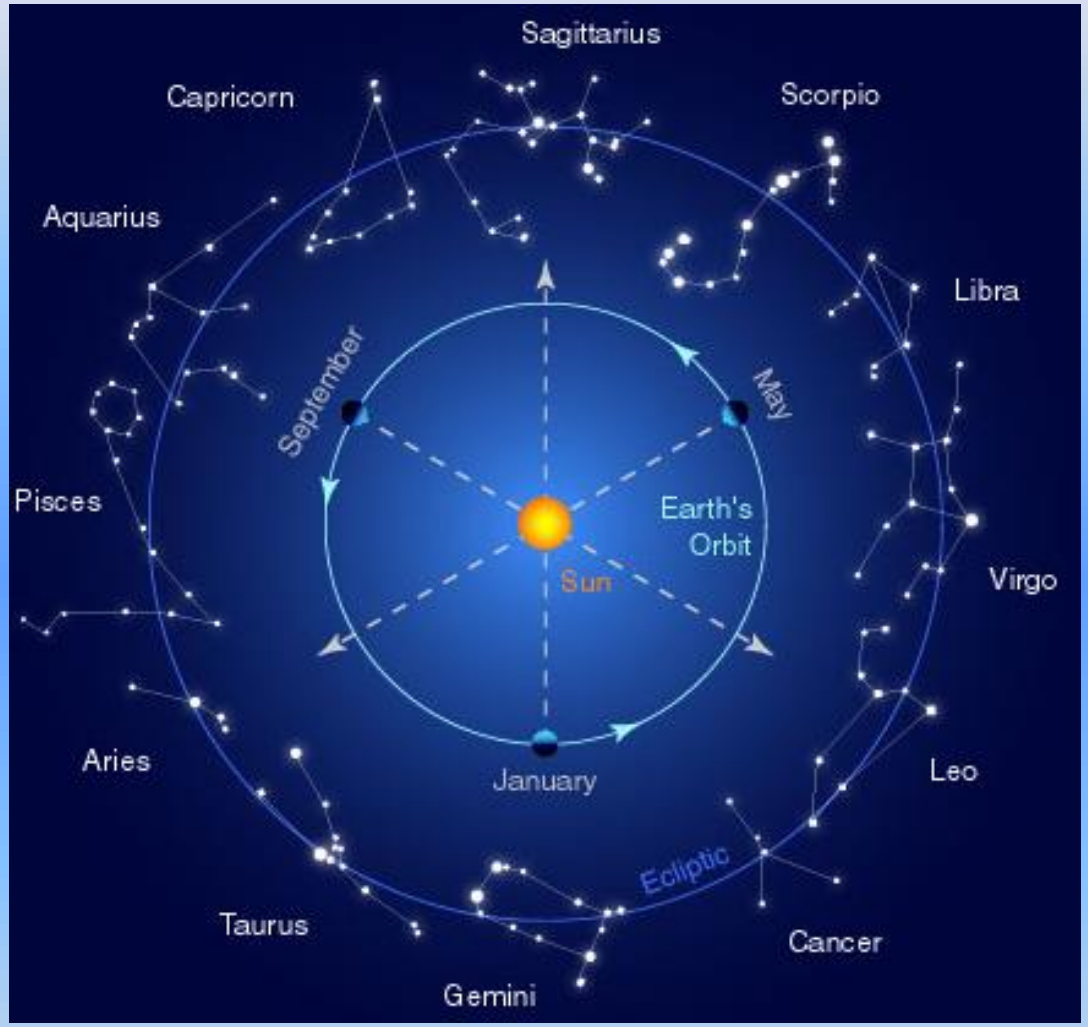
Precession

Earth's Axis "Wobbles"



Vega will eventually be the North Star

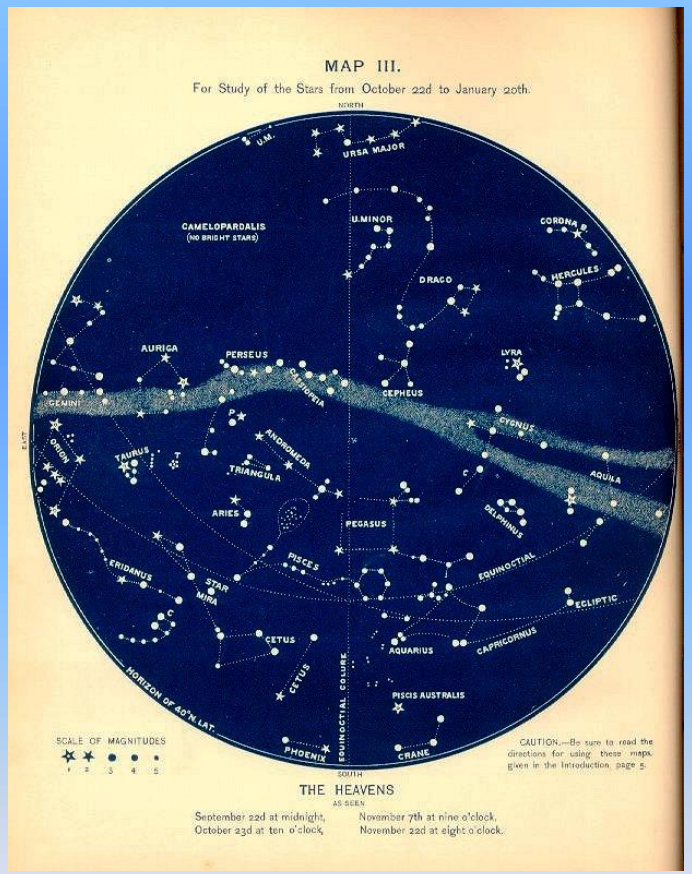
Seasonal Changes in Constellations



a. If Earth didn't revolve we would see the same constellations in the sky throughout the year.

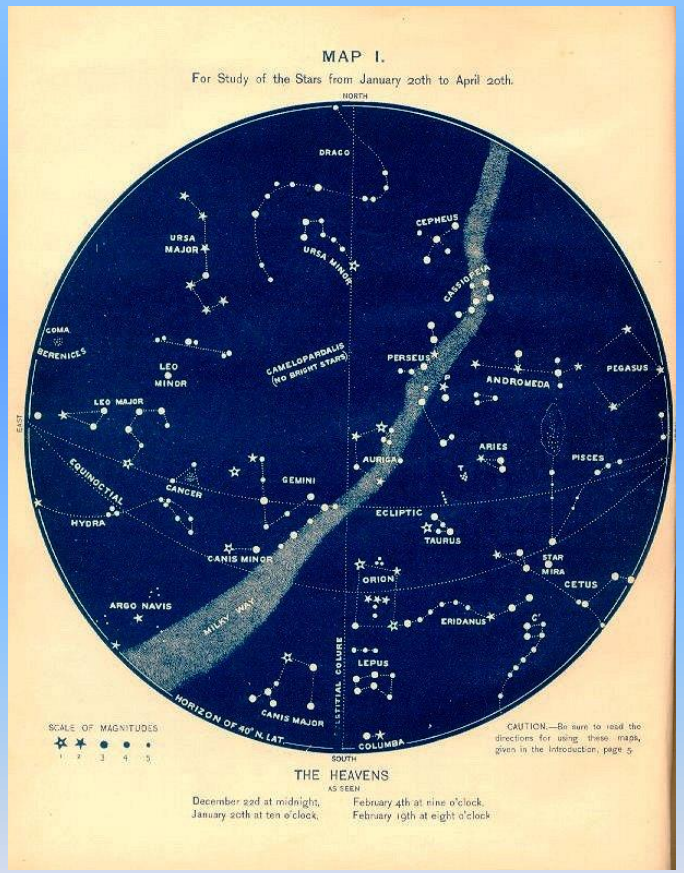
b. As Earth revolves, the night side faces a different part of the celestial sphere. As a result, there is a seasonal change in constellations observed.

Constellations Seen at Night Change with the Seasons



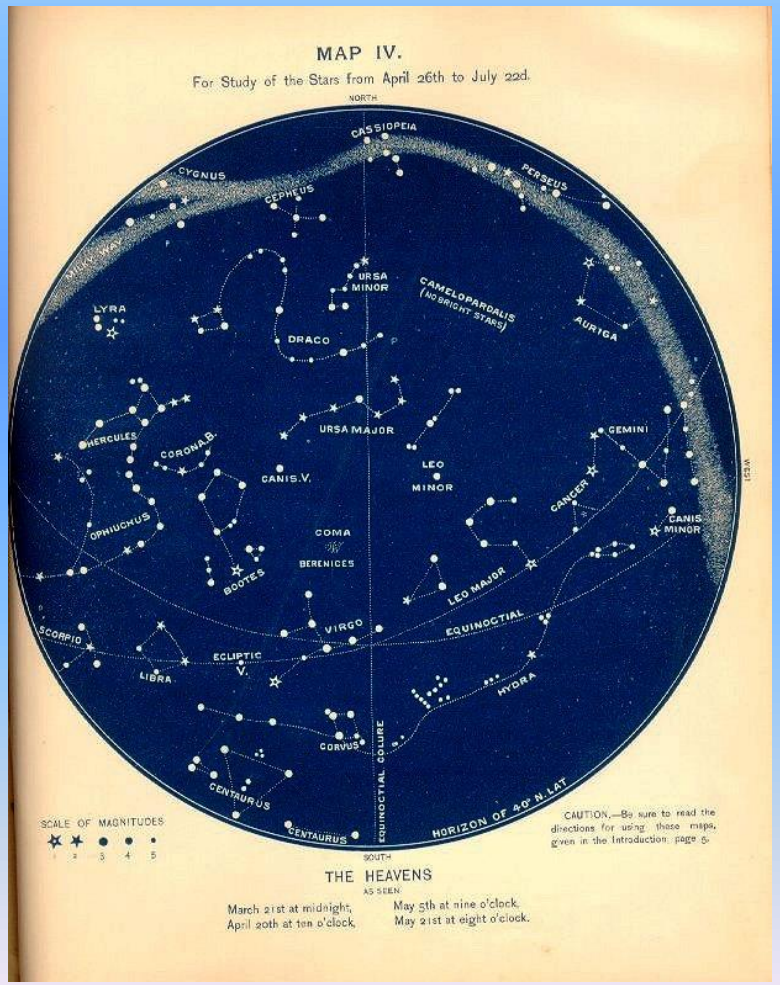
Autumn

Constellations Seen at Night Change with the Seasons



Winter

Constellations Seen at Night Change with the Seasons



Spring

Constellations Seen at Night Change with the Seasons

Summer