ASTRONOMICAL SURVEY

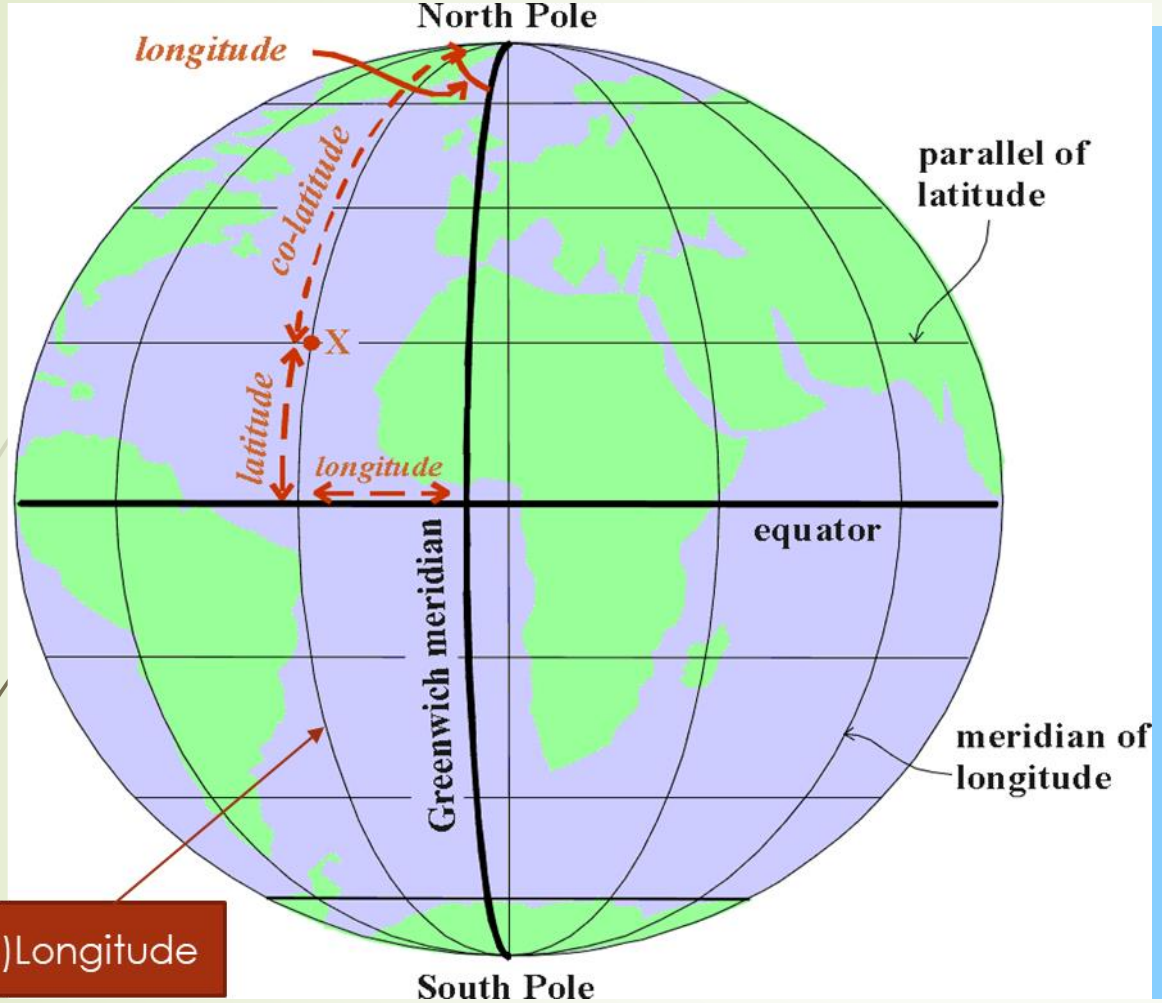
What we will discuss:

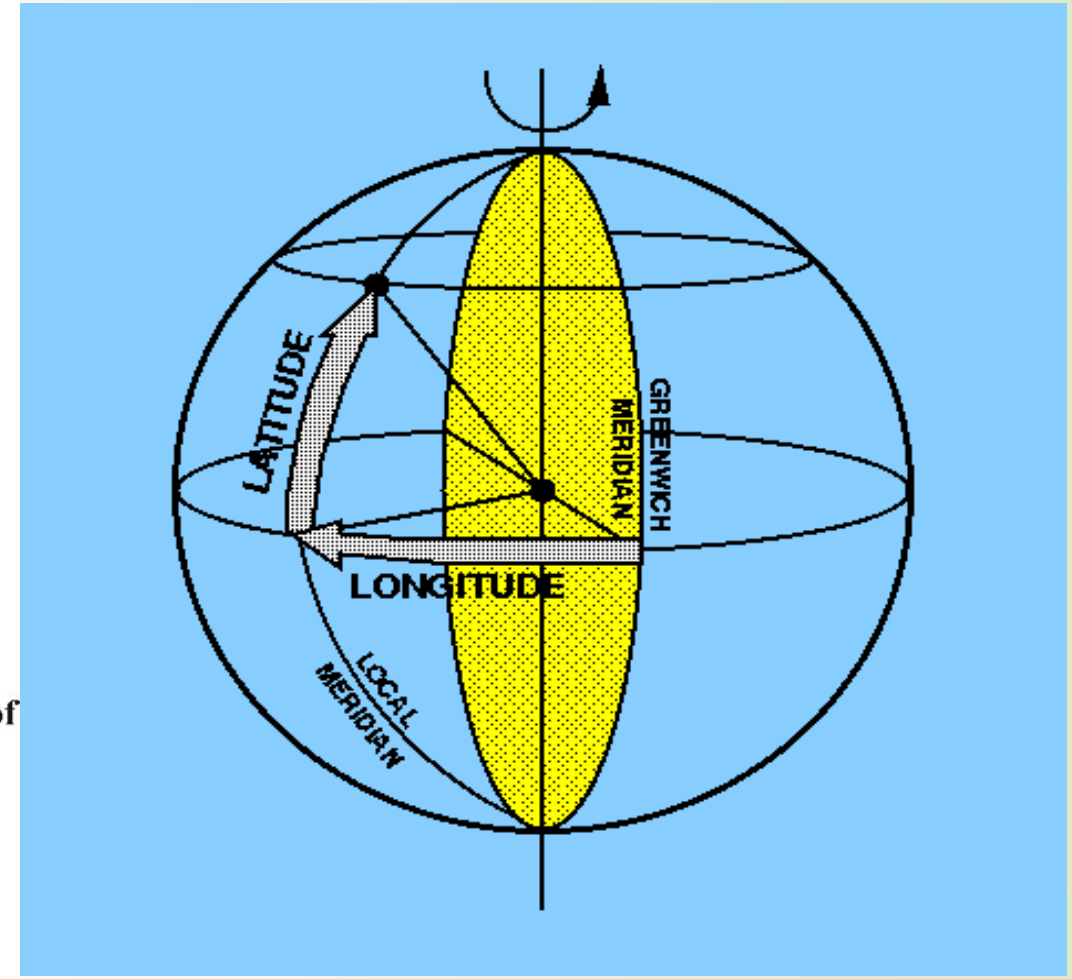
- Location of ‘x’ on earth’s surface
- Longitude and Latitude
- Parallels or Circles of Latitudes
- Prime Meridian
- Celestial Sphere, Zenith, Nadir, Horizon, Azimuth, Declination, RA, Hour Circle & Angle, Ecliptic.
- Equinox and Solstice
- Zones of the Earth

Describe a location X on the surface of the Earth: **Use latitude and longitude**

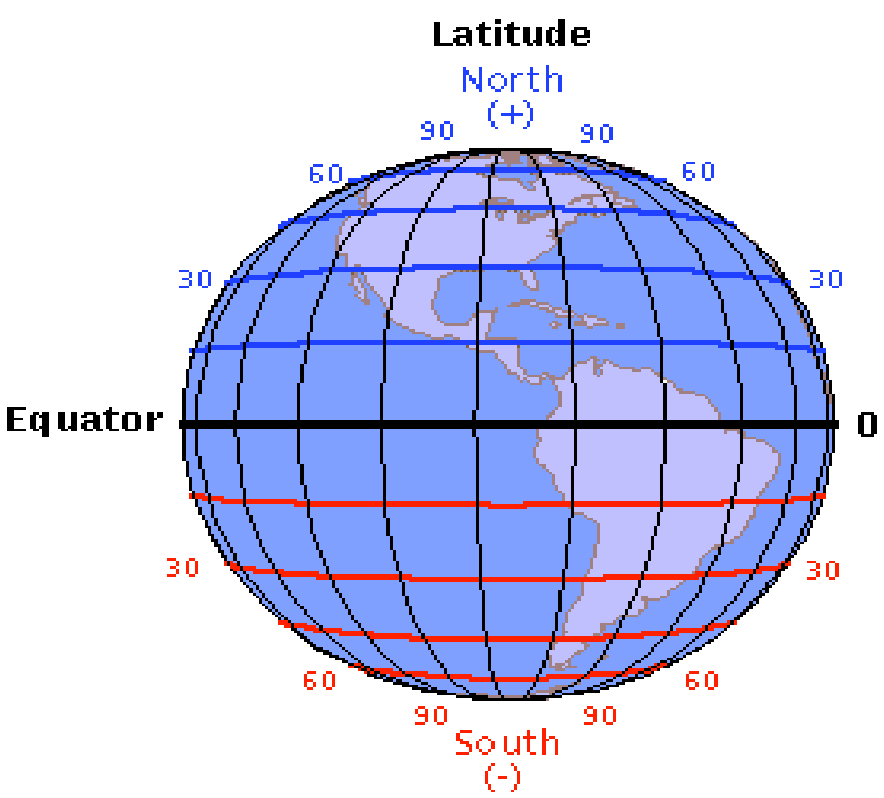
- **Meridian of longitude**: Draw a great circle from pole to pole, passing through location X.
- **Latitude of X: Angular distance along this meridian** from the **equator to X**, measured from -90° at the South Pole to +90° at the North Pole.
- **Longitude of X: Angular distance along the equator** from the **Prime Meridian to the meridian through X,** measured east or west ie. both ways 0° to 180°.
- **Parallels of latitude**: Small circles parallel to equator.

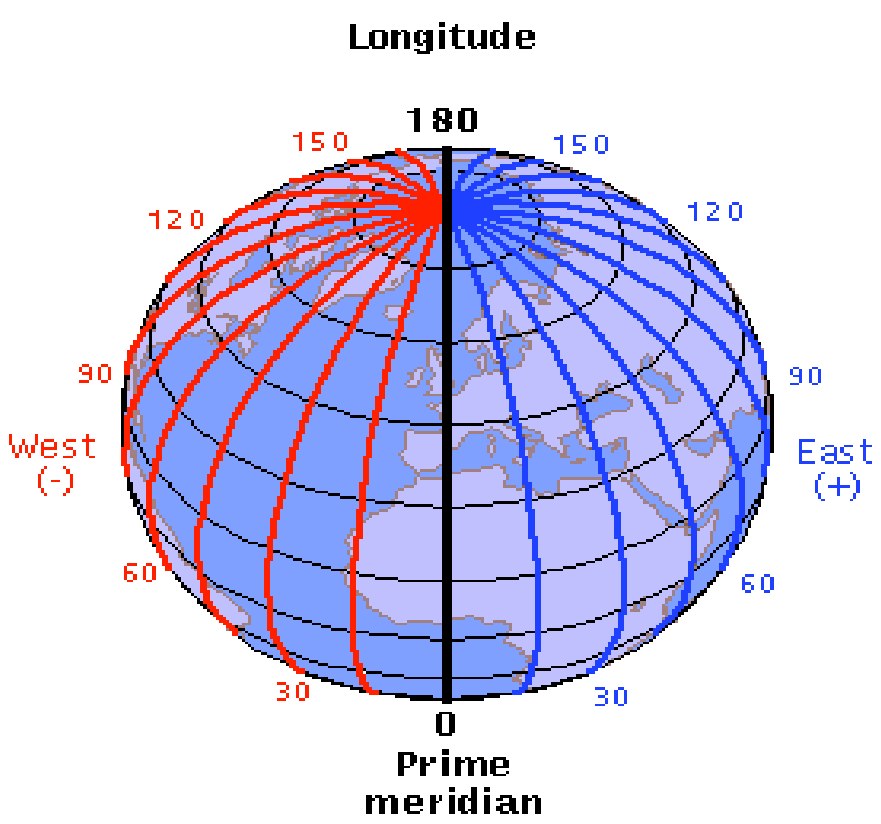
- **Nautical mile:** As 1 arc-minute along a great circle on Earth's surface, **comes out about 15%** greater than the normal "statute" mile (6080 feet instead of 5280 feet).



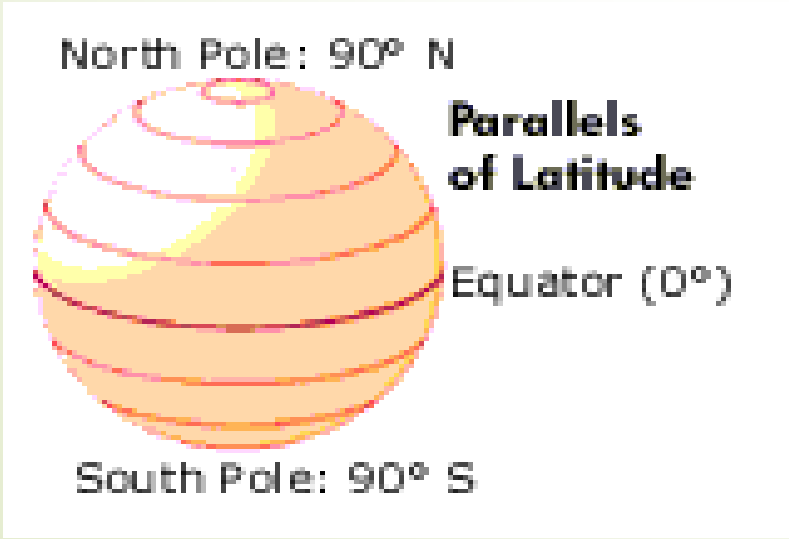


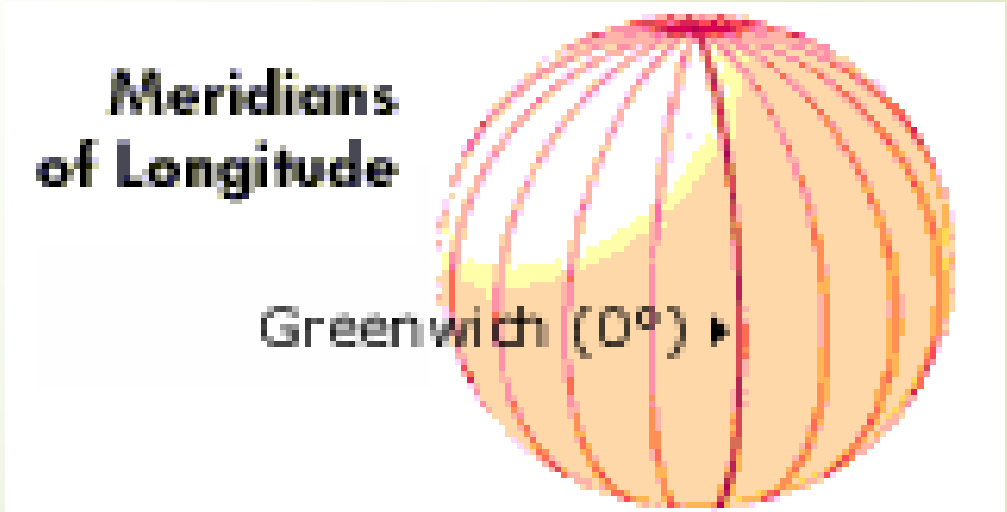
Meridian of (X)Longitude





Microsoft Illustration





Longitude and Latitude:

- **Are angular measurements** that **give a location** on the earth's surface, a unique geographical identification.

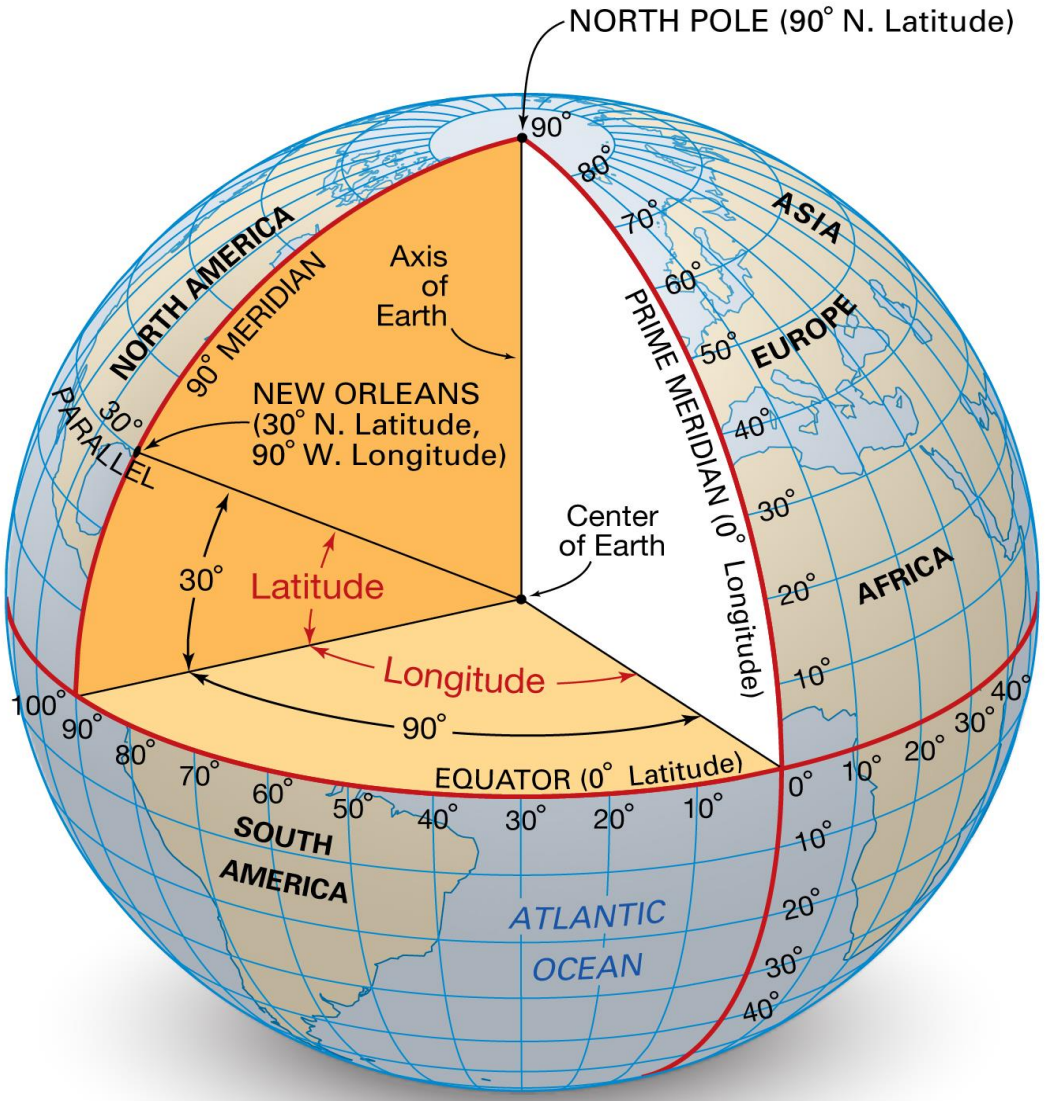
- **Latitudes** are the **progressive angular measurements** towards **north or south of the equator** and **run from east to west**.

- **Longitudes** are the **progressive angular measurements** towards **east or west of the Prime Meridian** and **run** from the north pole to the south pole.

- **Latitudes are parallel** while **Longitudes** are **convergent.**
- **Positioning method** comprises of a coordinate system in degrees (°) **with the Equator** and **Prime Meridian** being the lines that **denote 0°.**
- **With the Equator as the reference point**, the **North Pole lies at 90°N and the South Pole lies at 90°S.**
- **Furthest point eastwards from the Prime Meridian is expressed as 180°E** and the furthest point westward is expressed as 180°W.

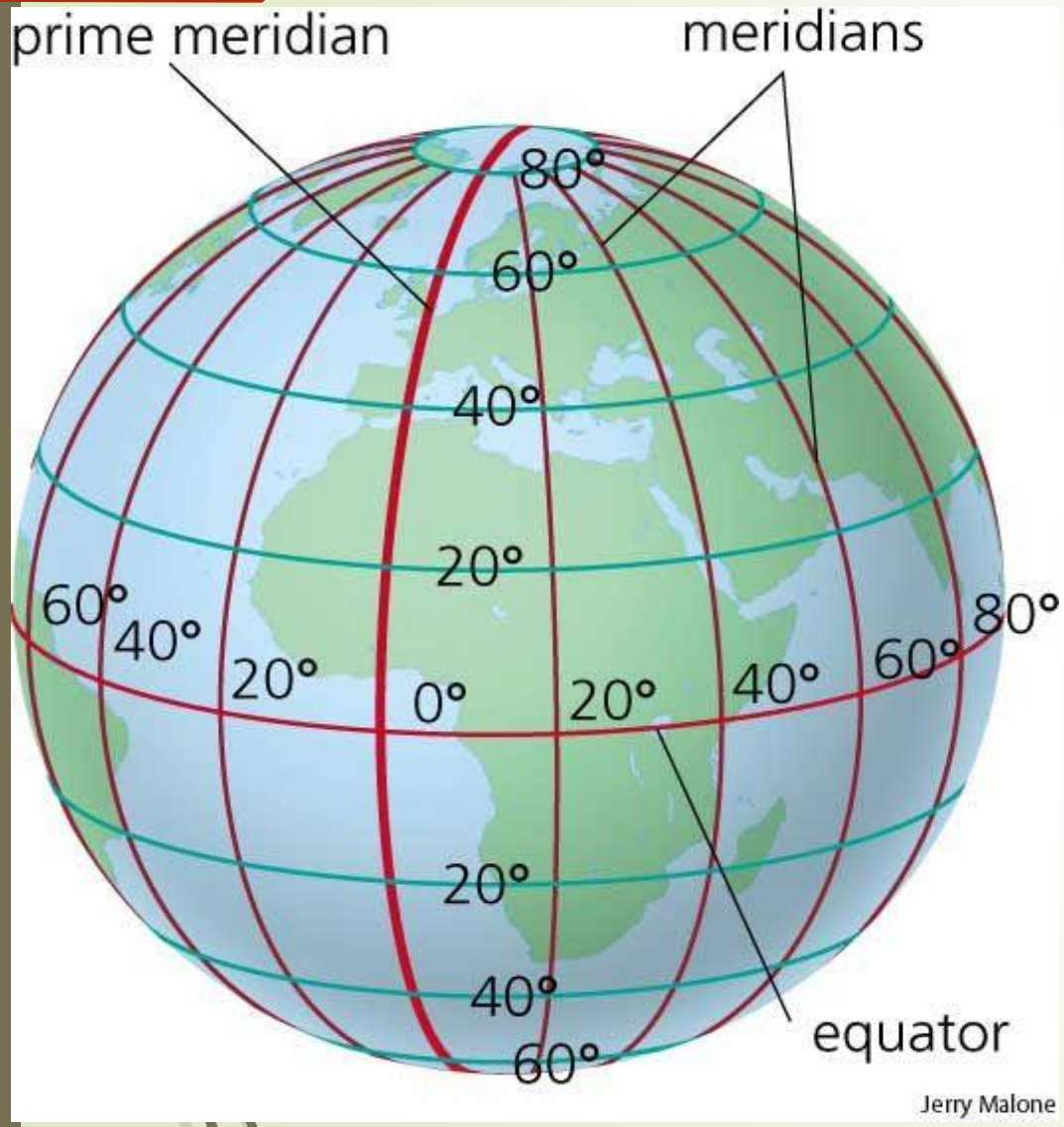
Circles of Latitude/Parallels:

- Imaginary **east to west circles** that connect all places with the same latitude.
- All **Circles of Latitude are parallel to the Equator** and **perpendicular to all Longitudes** at the intersection points.
- **Parallels get smaller towards the poles.**
- Equator as the **central circle of Latitude**.



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Meridian:



- **Imaginary line** between north and south pole through the **observer's position**.
- **Prime Meridian also known as Greenwich Meridian** has been set as the **reference line of meridians.**
- **Half of a longitudinal circle** is called a Meridian.
- Meridians are **important for setting time zones.**

Greenwich /Prime Meridian

- The **0 degree line of longitude** that passes through the **Royal Observatory in Greenwich,** England is called the Greenwich Meridian.
- Also called the **Prime Meridian**.
- Line is the **starting point for longitudinal lines** that run north-south and converge at the poles.
- Greenwich Meridian (or prime meridian) is a 0° line of longitude from which we **measure 180° to the west and 180° to the east**.
- These measurements are the basis of our **geographic reference grid**.





If you stand with one foot on one side and the other on the left, you are perfectly **in the middle of east hemisphere and west hemisphere**, according to the prime meridian line.

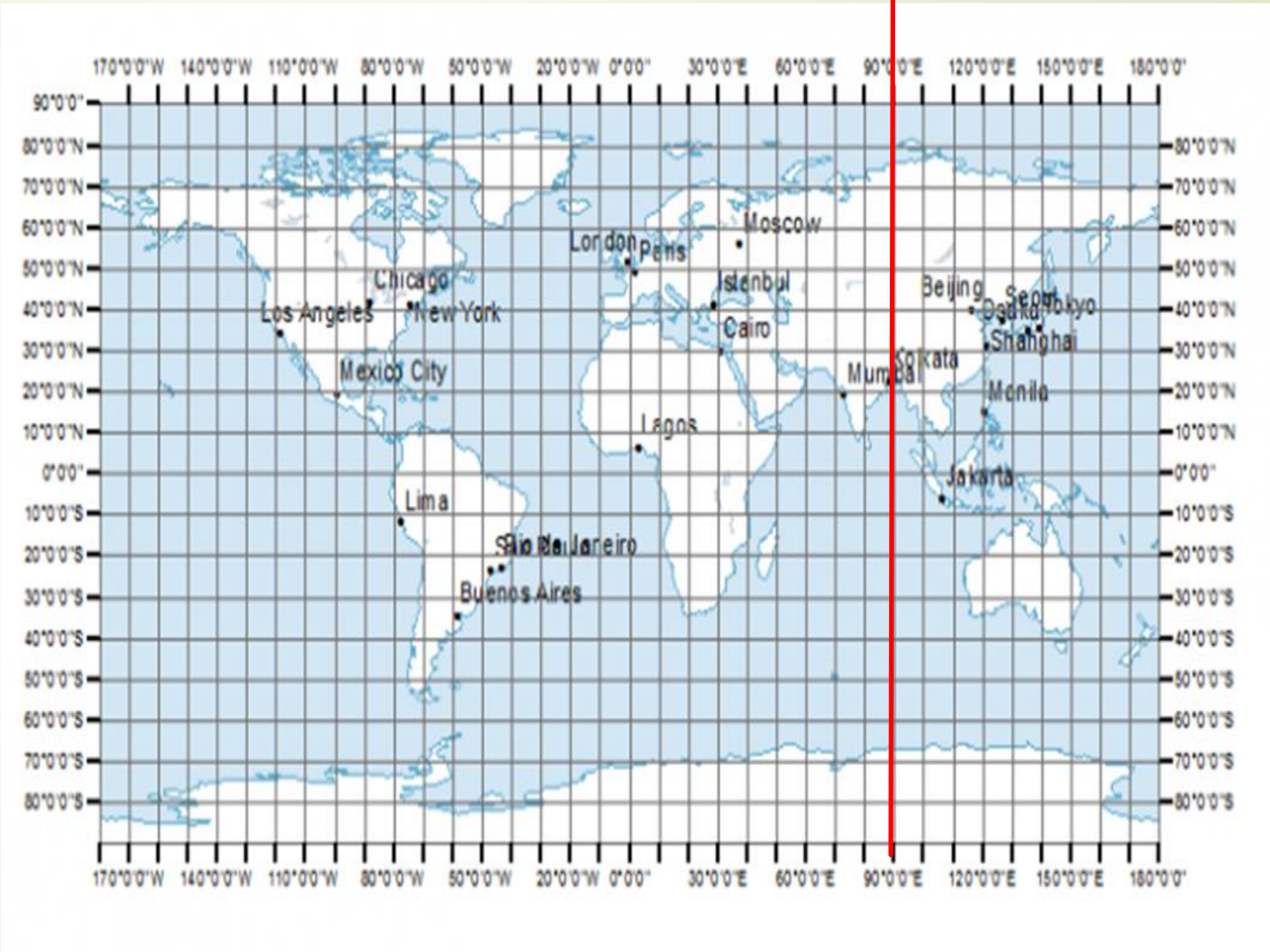
- Meridians are **important for setting time zones**.

Standard meridian of Bangladesh is **90.00°E** longitude, which passes over the Harukandi Union of Harirampur Upazila of the Manikganj District, Bangladesh.

$$\frac{12x90}{180}=6E=+6$$

Standard Meridian of India has a longitude of **82°30'E**. This Standard meridian passes through **Mirzapur in Uttar Pradesh** and it is considered as the standard time for the whole country.

$$\frac{12x82.5}{180}=5.5E=+5.5$$

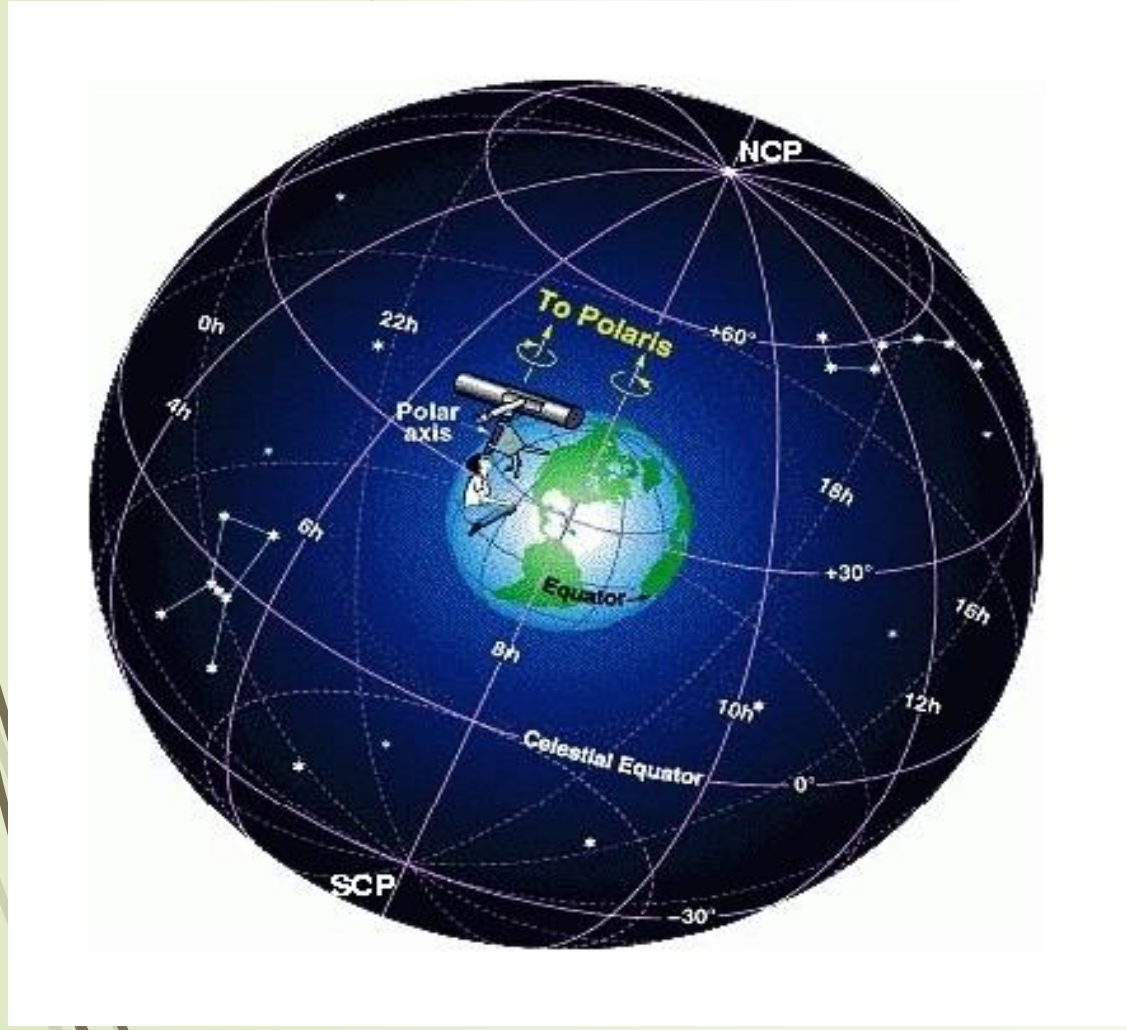


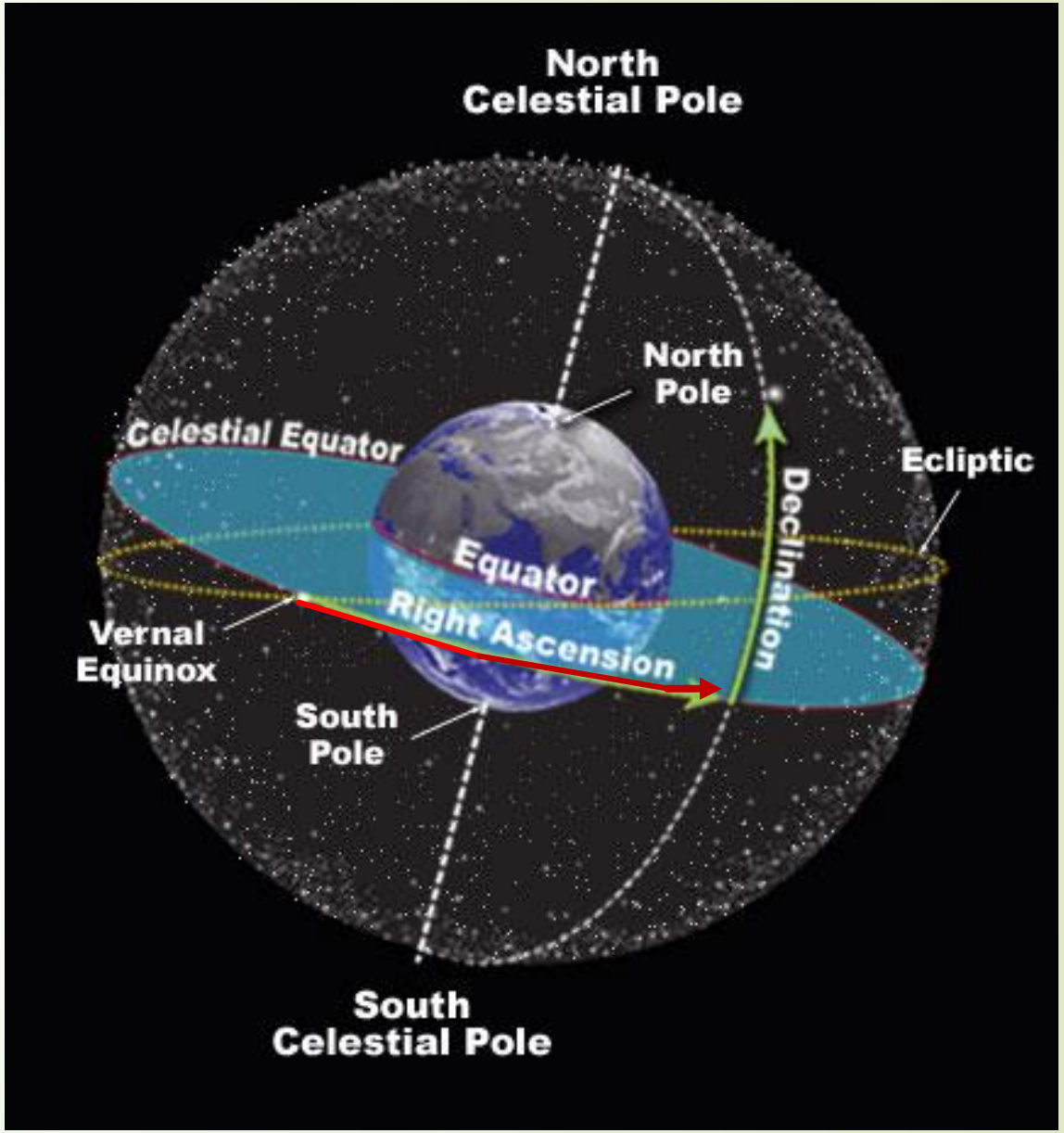
Celestial Sphere

Declination – Latitude

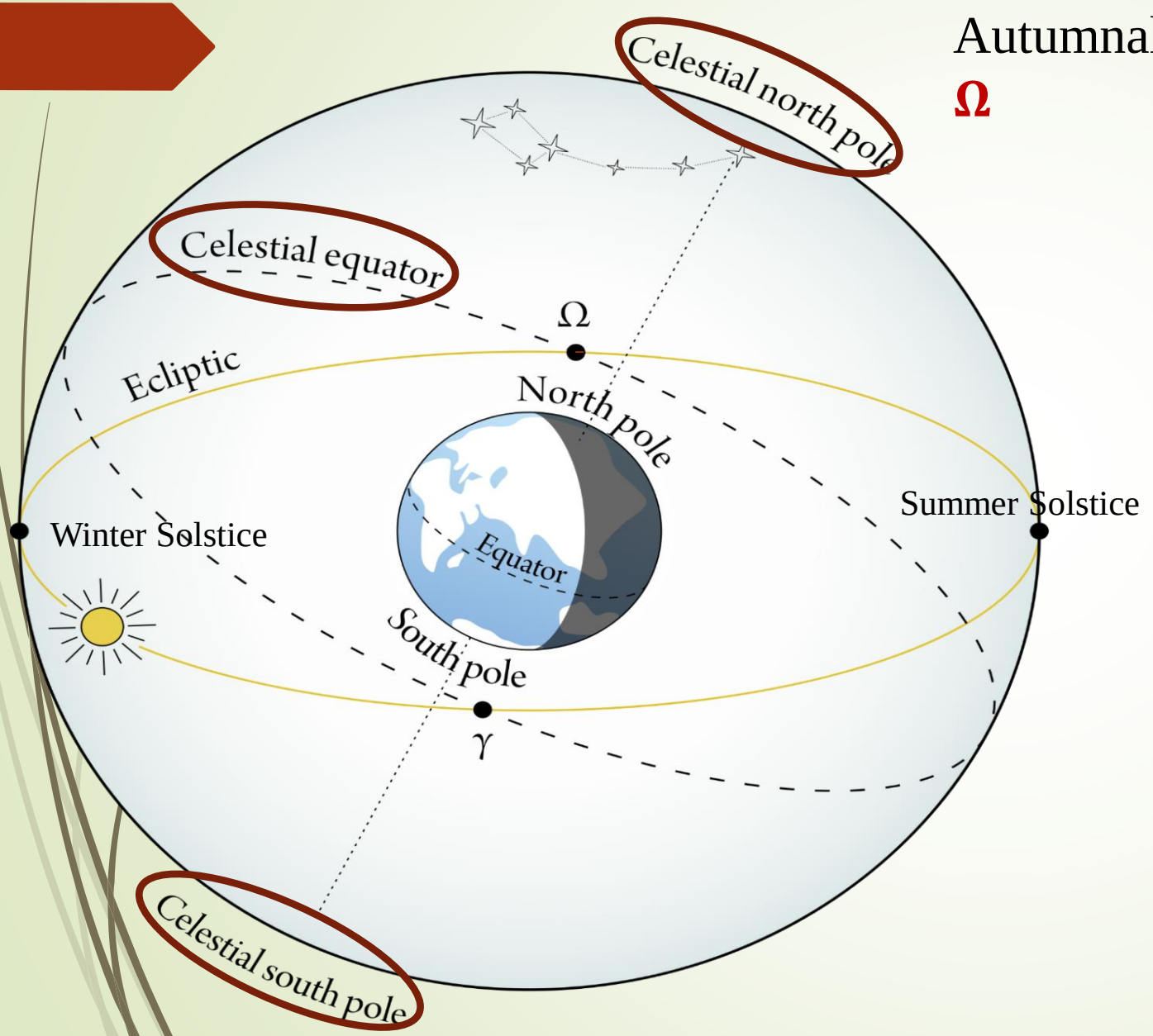
Vernal Equinox – Prime Meridian

Right Ascension - Longitude





Celestial Poles and Celestial Equator:



First Point of Libra or Autumnal Equinox or **Ω**

First Point of Aries or Vernal Equinox or **γ**

Equinox:

Time or date (twice each year) at which the sun crosses the celestial equator, when day and night are of **approximately equal length** (about 22 September and 20 March).

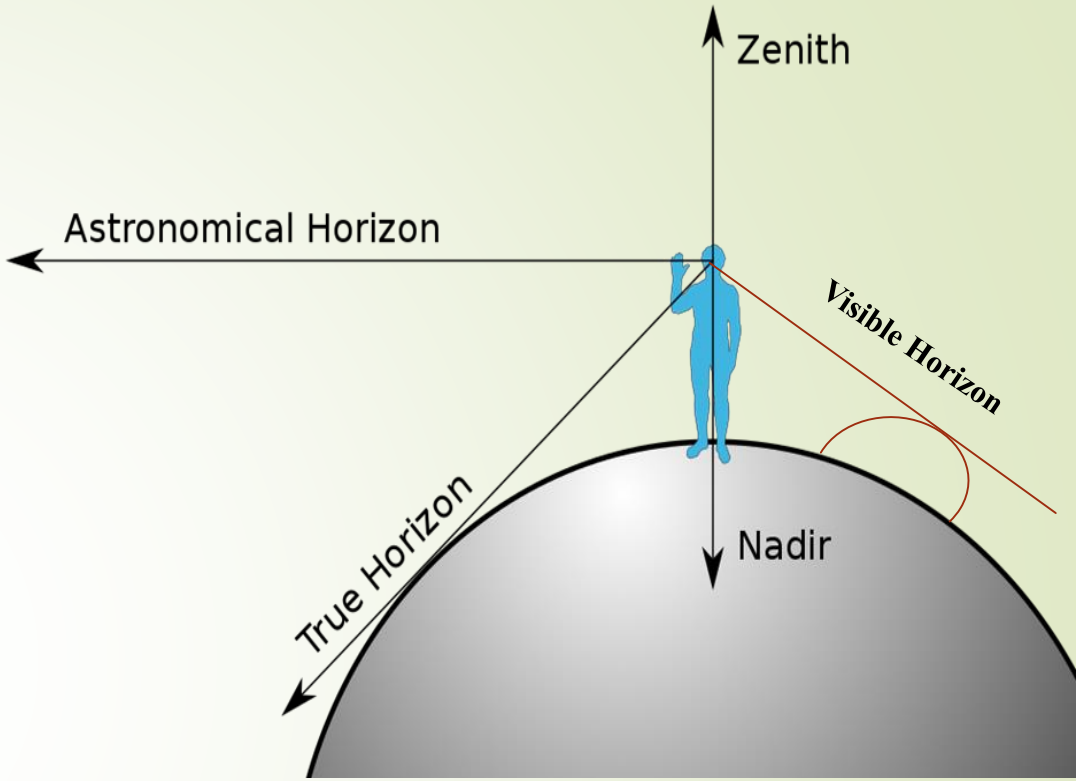
Solstice:

Time or date (twice each year) at which the sun reaches its maximum or minimum declination, marked by the **longest and shortest days** (about 21 June and 22 December).

Zenith:

- **An imaginary point directly "above" a particular location, on** the imaginary celestial sphere.

- **Zenith is the "highest" point on the celestial sphere.**

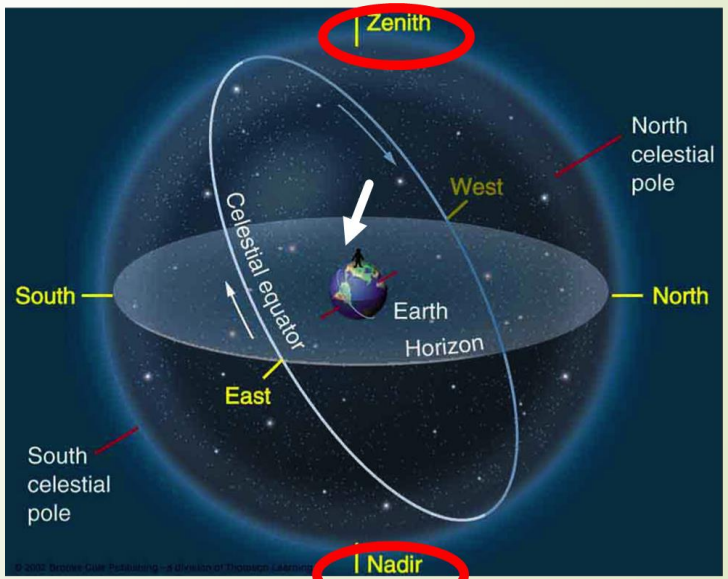


Nadir:

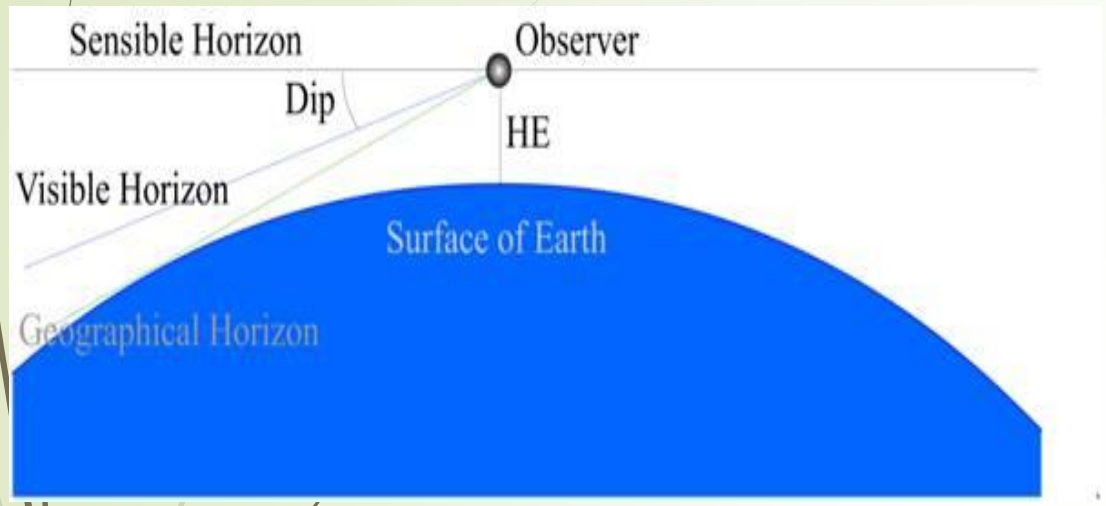
- **Direction pointing directly below a particular location**; that is, it is one of two vertical directions at a specified location, **orthogonal to a horizontal flat surface there.**

- **Local vertical direction pointing in the direction of the force of gravity** at that location.

- **Direction opposite of the nadir** is the zenith.



Visible Horizon



Horizon:

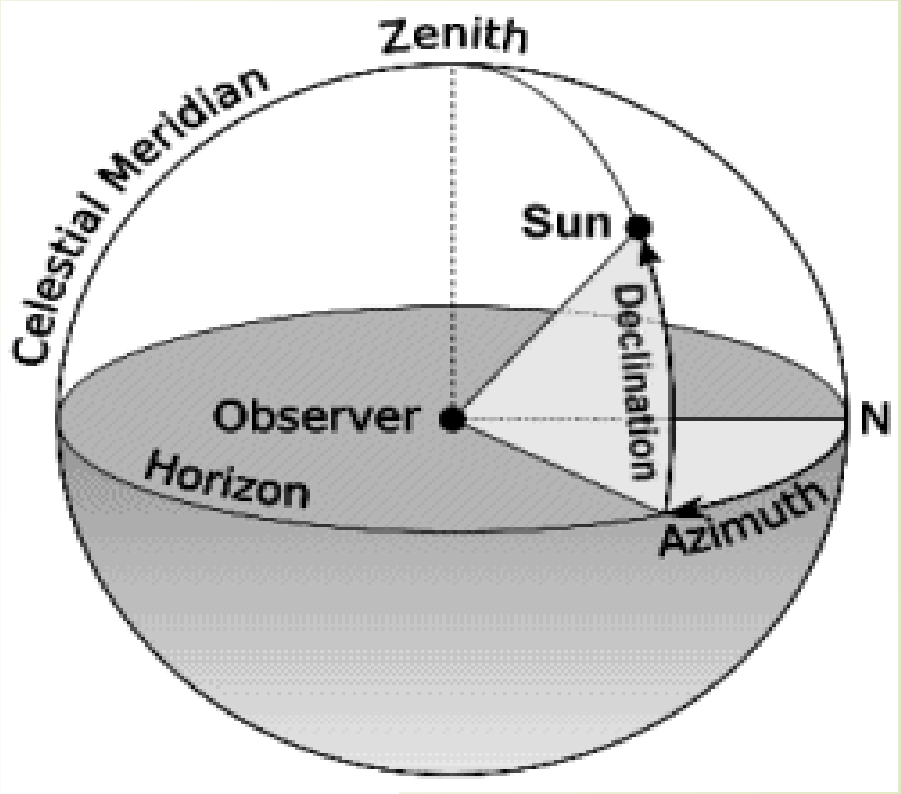
- **<u>Boundary</u>** where the sky **seems to meet** the ground or sea.
- **Higher the observer**, the **lower** and **more distant** is his visible horizon

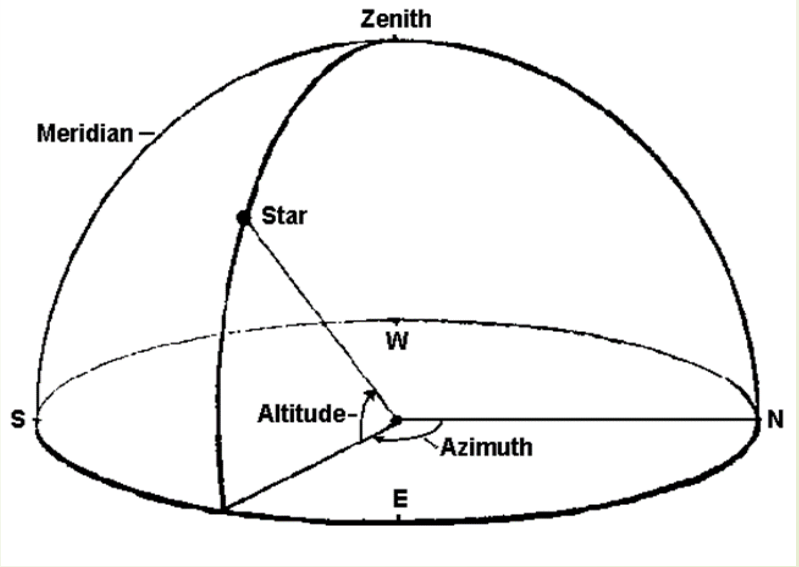
Azimuth (A), Declination (δ)

Azimuth: It is the **angle measured from North through East** in degrees.

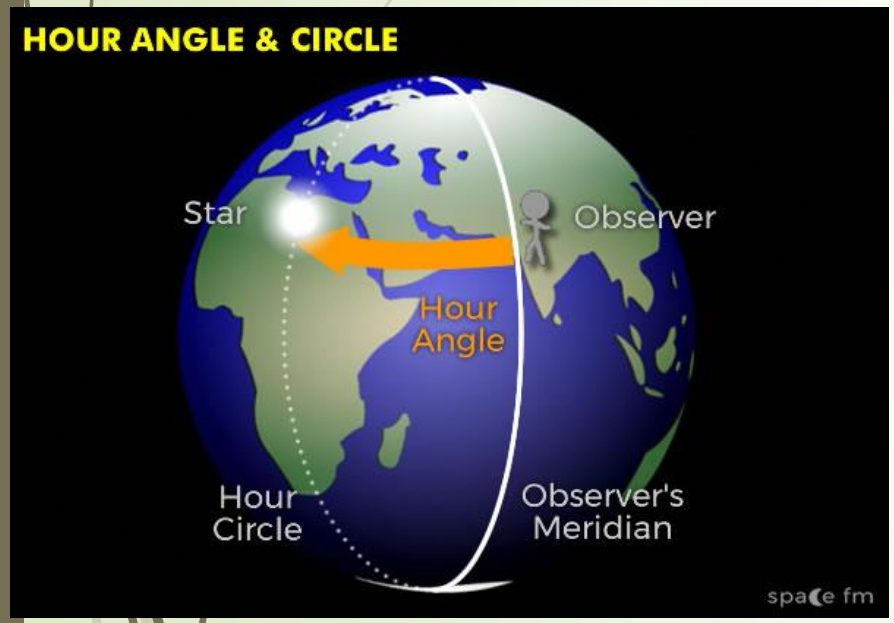
Altitude: It is the **elevation of an object from the horizon.**

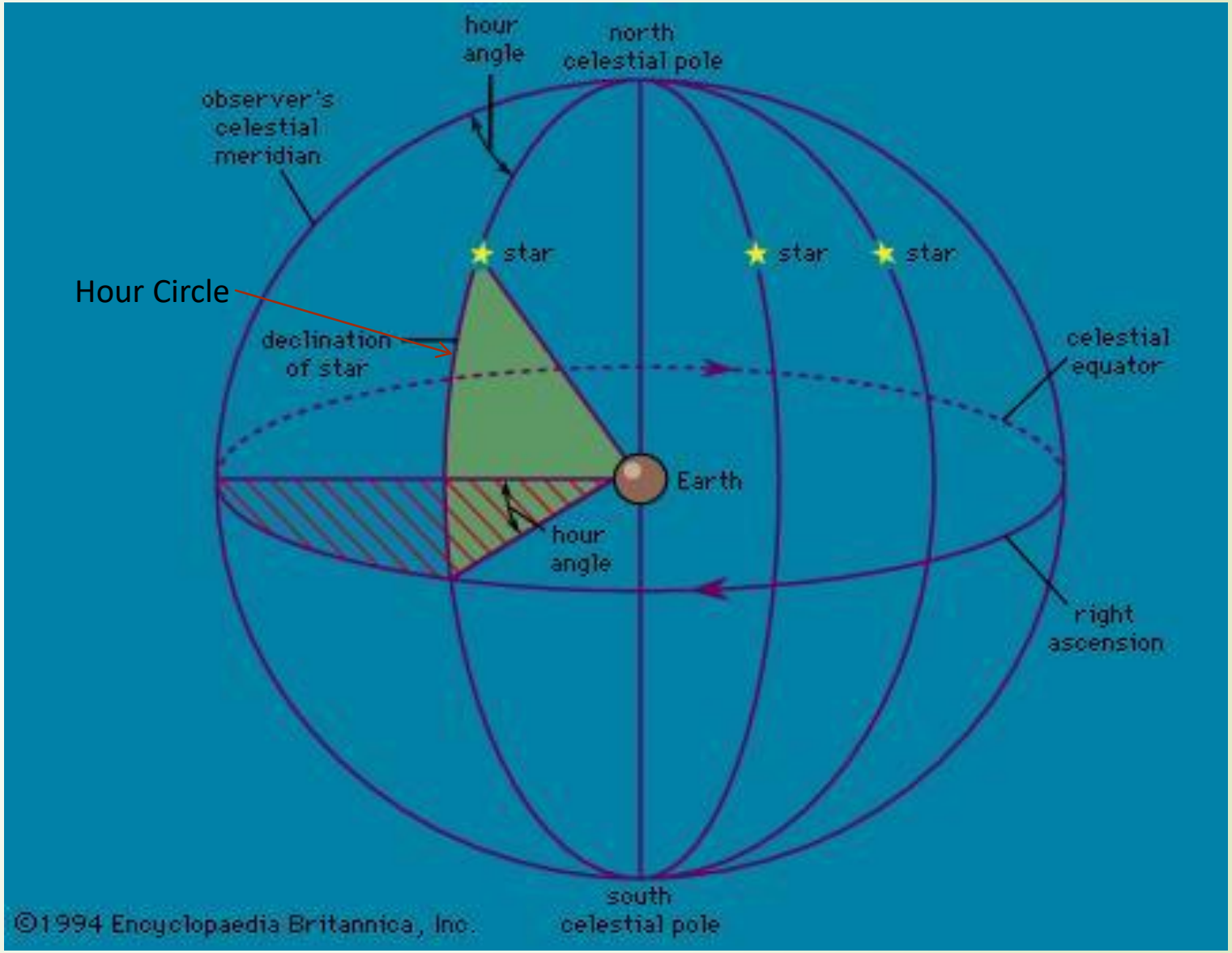
Declination: It is the **equivalent of Latitude in celestial sphere.**





Hour Circle & Hour Angle:





Hour circle:

- Any **great circle (similar to longitude)** on the celestial sphere that **passes through the celestial poles—i.e.**, is perpendicular to the celestial equator.

- **Declination of a celestial object is measured along its hour circle**.

Hour angle:

- **Angle between an observer's meridian** (a great circle passing over his head and through the celestial poles) and **the hour circle** (any other great circle passing through the poles) **on which some celestial body lies**.
-
- Expressed in hours and minutes, ie. **time elapsed since the celestial body's last transit of the observer's meridian**.

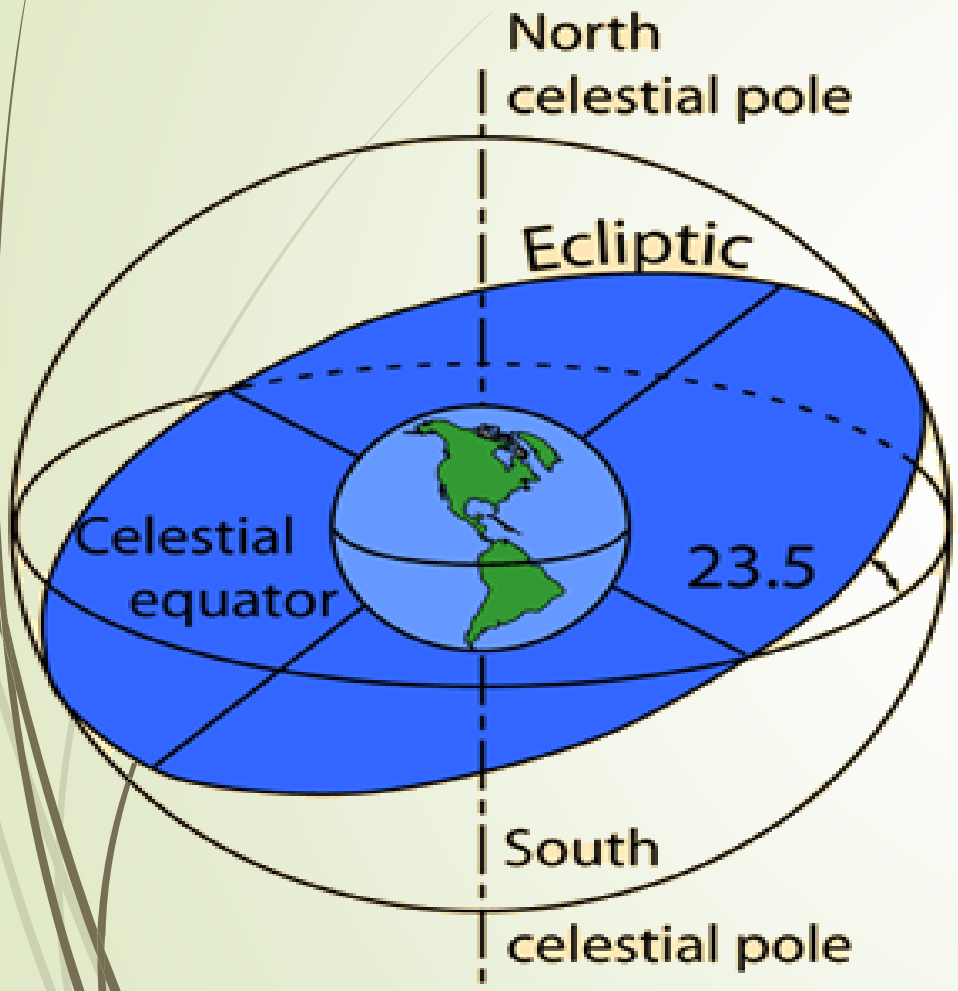
- Can also be expressed in degrees, **15° of arc being equal to one hour**.

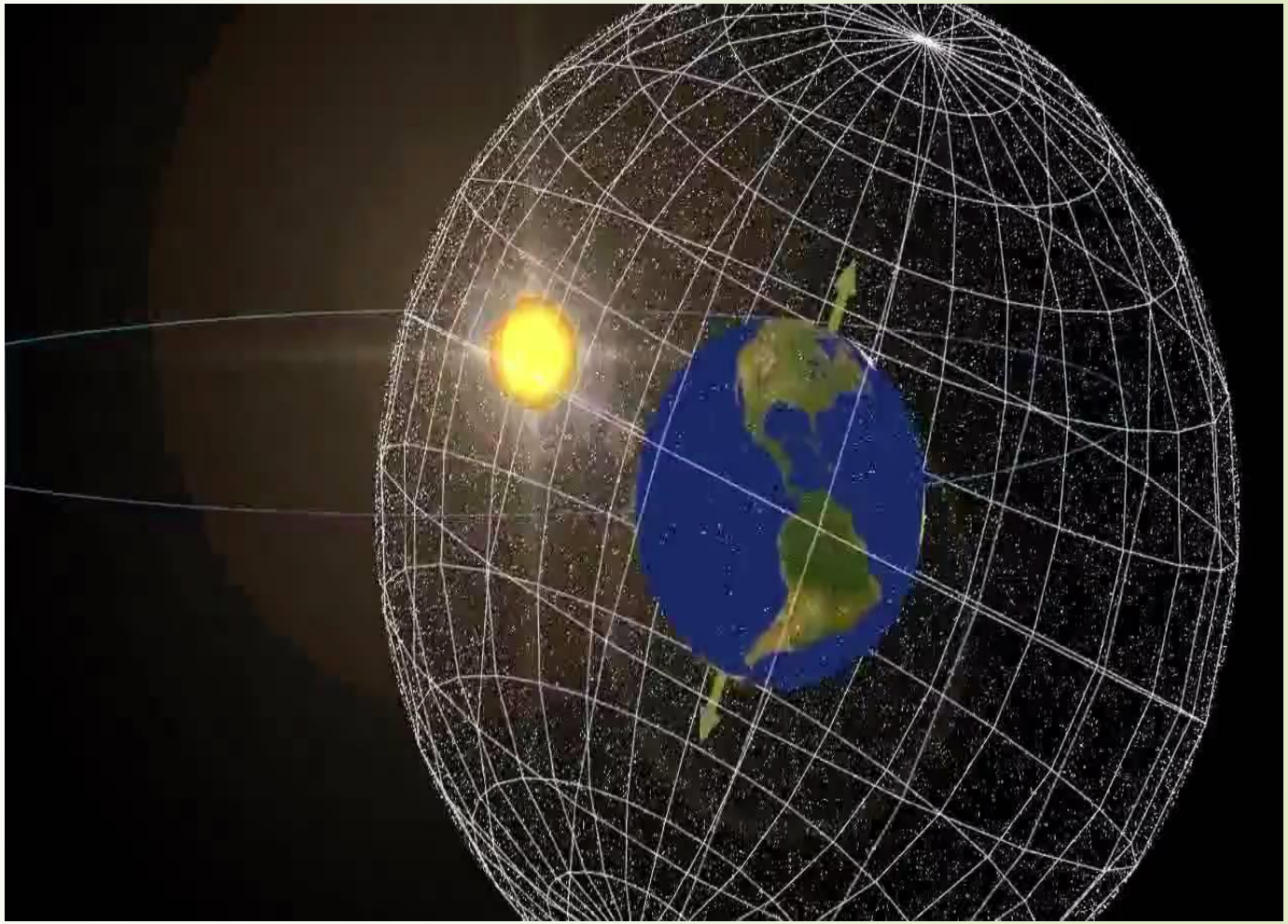
Ecliptic:

- If the **sun's path is observed from the Earth's reference frame**, it appears to **move around the Earth in a path** which is **tilted with respect to the spin axis** at 23.5°.

- Path is called the ecliptic.

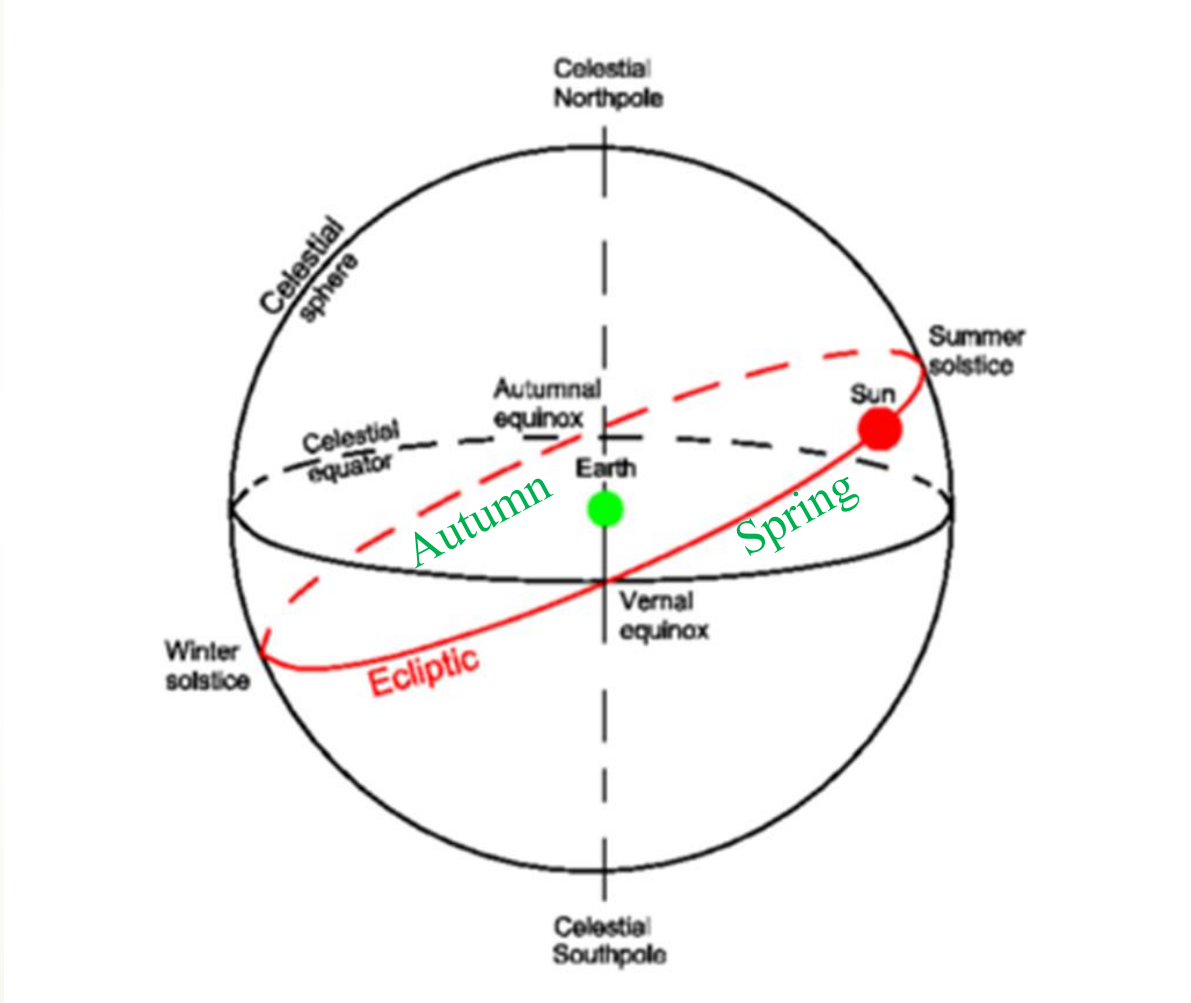



North
celestial pole
Ecliptic
Celestial
equator
23.5
South
celestial pole



Equinox:

- Word '**equinox**' comes from Latin and means "**equality of night and day**."
- **Equinox occurs twice a year**, **marking the onset of both spring and autumn**.
- **During the equinox**, the **sun crosses the plane of Earth's equator**, making **night time and day time (roughly) equal** length all over the world.



Contrary to popular belief, the equinox doesn’t last for a full 24 hours; rather, it **occurs at two specific moments in time** when the **sun is exactly above the celestial equator.**

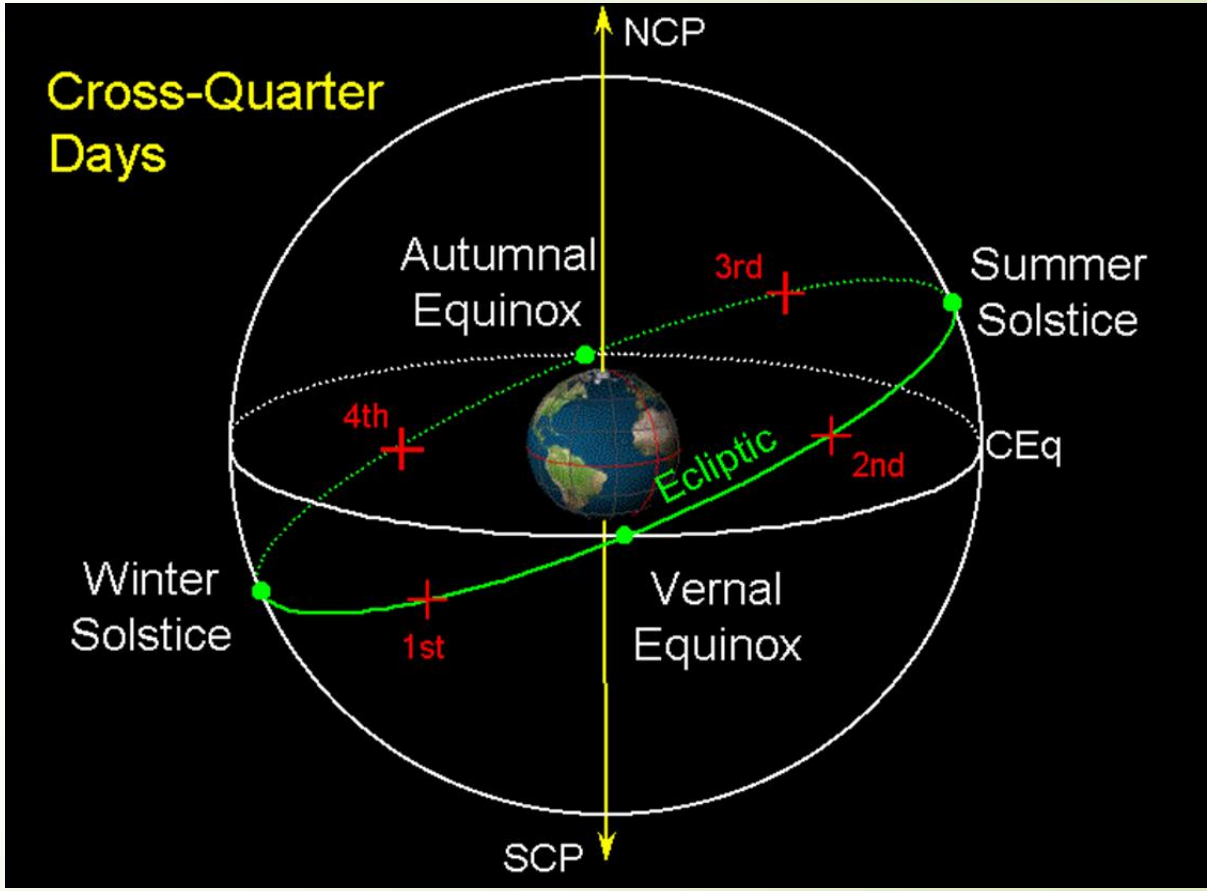
Spring equinox, or vernal equinox/First point of Aries: It occurs around **March 21st,** when the sun moves northward across the celestial equator.

Autumnal equinox, or September equinox/First Point of Libra: It occurs around **September 22nd**, when the sun crosses the celestial equator going south.

Solstice:

- Term **solstice** is derived from the **Latin** **solstitium**. Latin **sol**, "**the sun**," and **sistere**, "**to make stand, stand still**."

- Term **solstice is used to describe the exact moment when the sun reaches** its **northernmost point** (around **June 21**, when the North Pole tilts closest to the sun) or **southernmost point** (around **December 22**, during the winter solstice) from Earth's equator.



Summer Solstice:

- Occurs around **June 21st** each year**.**
- **The sun is at its greatest distance from Earth's equator**, giving us the **longest day of the year,** which **marks the beginning of summer** in the Northern Hemisphere.

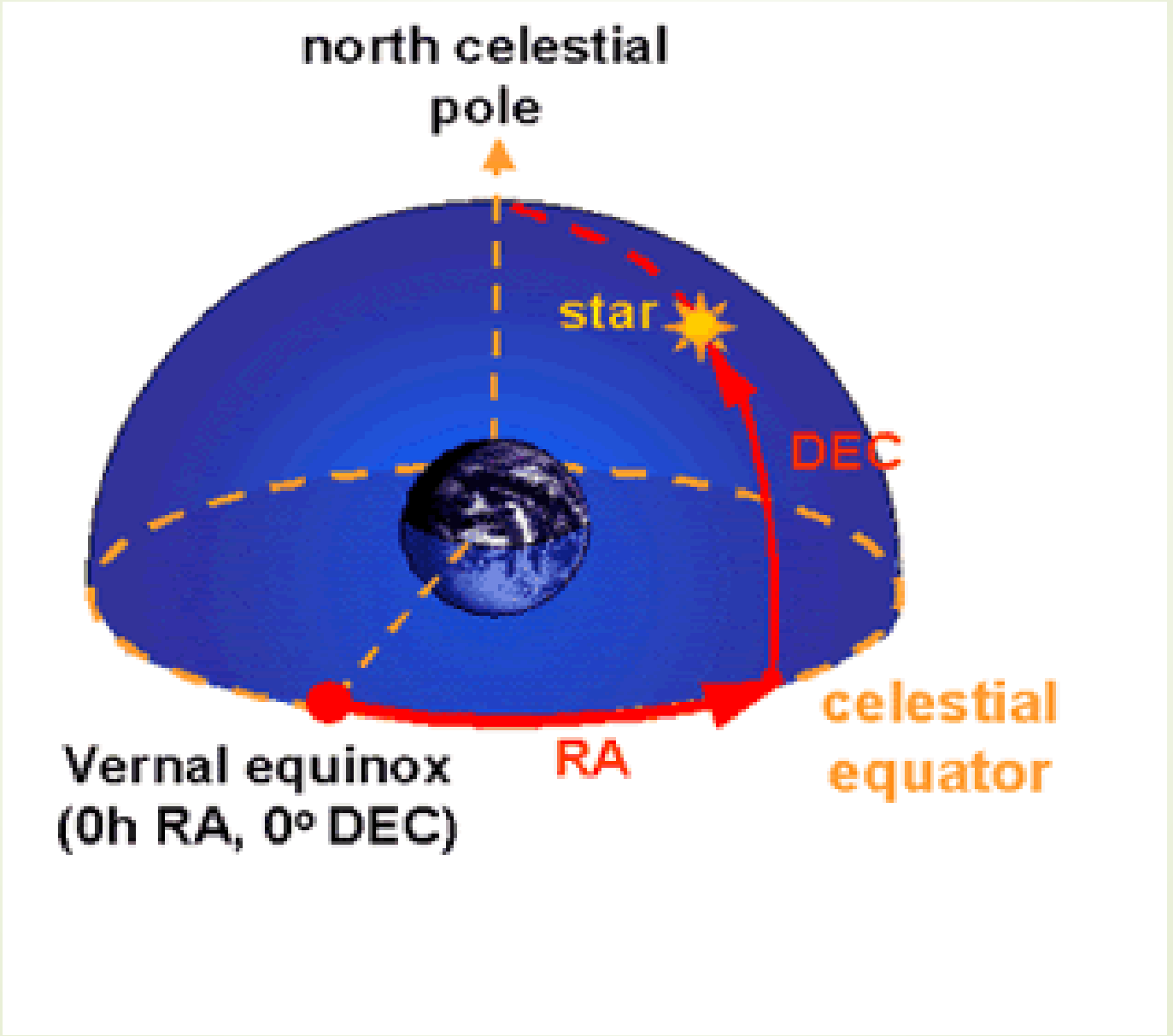
- A **Northern Hemisphere summer lasts** from the summer solstice to the autumnal equinox.

Winter solstice:

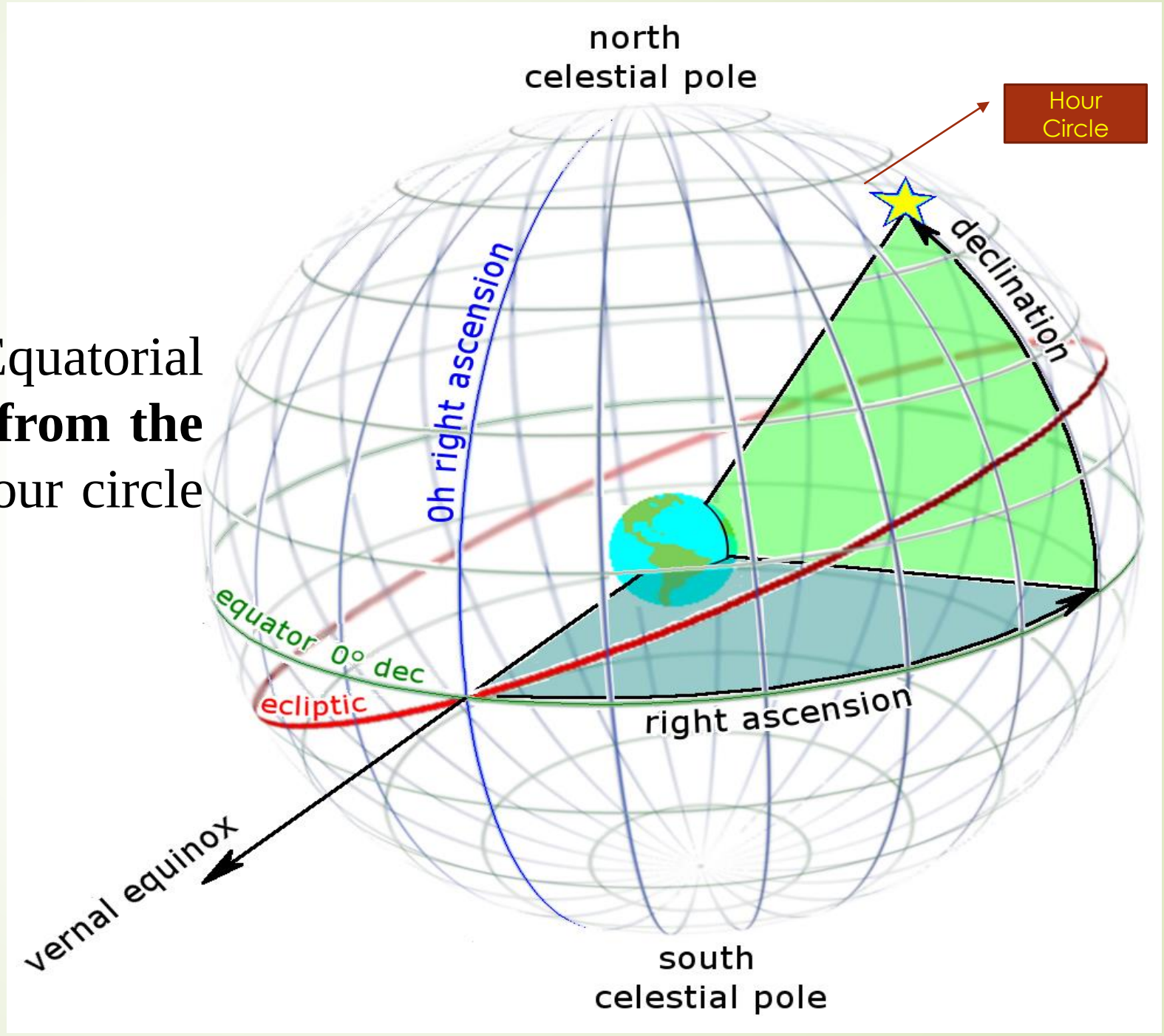
- Occurs around **December 22nd**, marking **Earth's closest proximity to the sun,** and giving us the **shortest day of the year**.

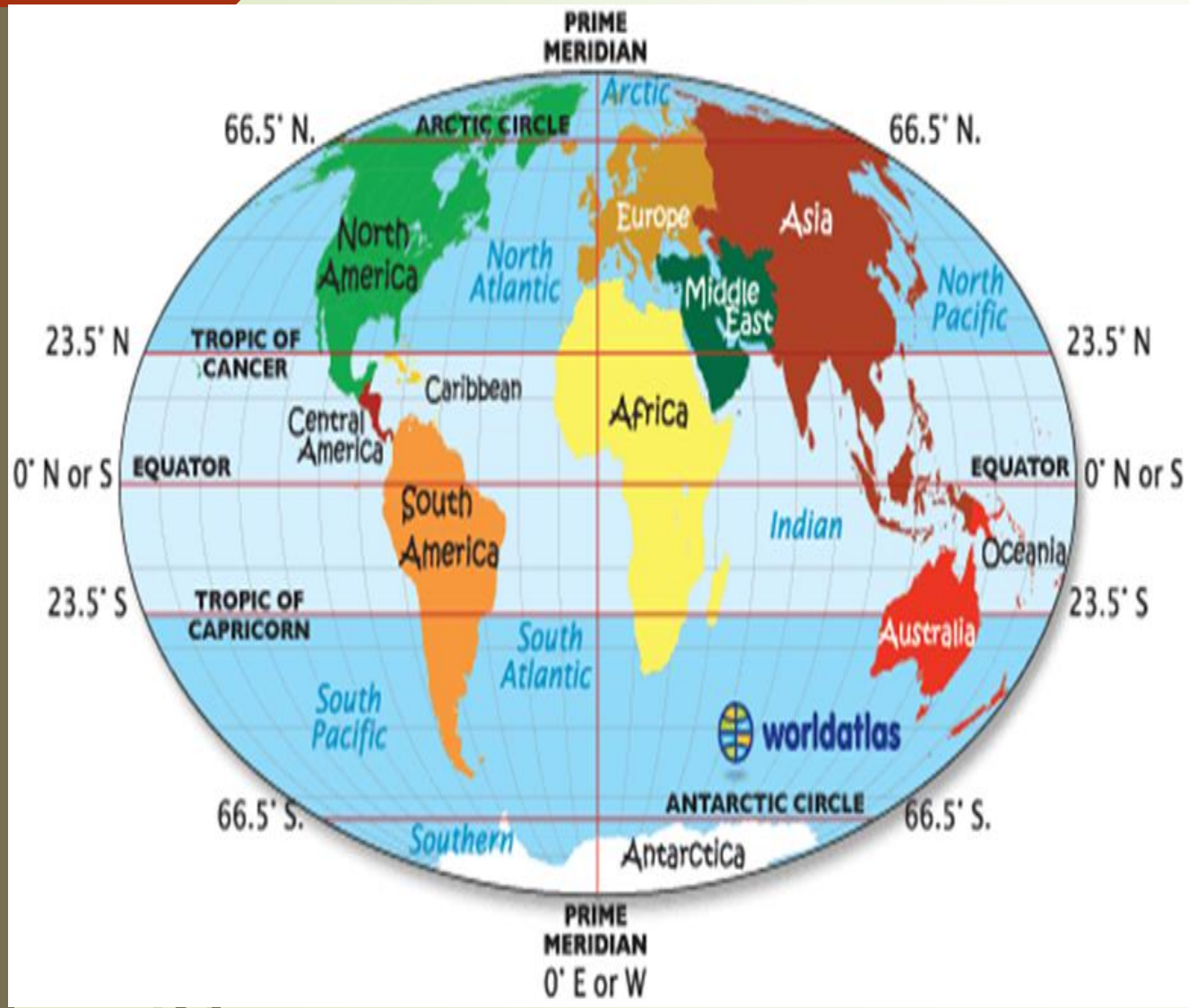
- Marks the **start of winter** in the Southern Hemisphere.

Right Ascension (R.A.):



Right Ascension RA is Equatorial **angular distance measured from the first point of Aries** to the hour circle through the heavenly body.





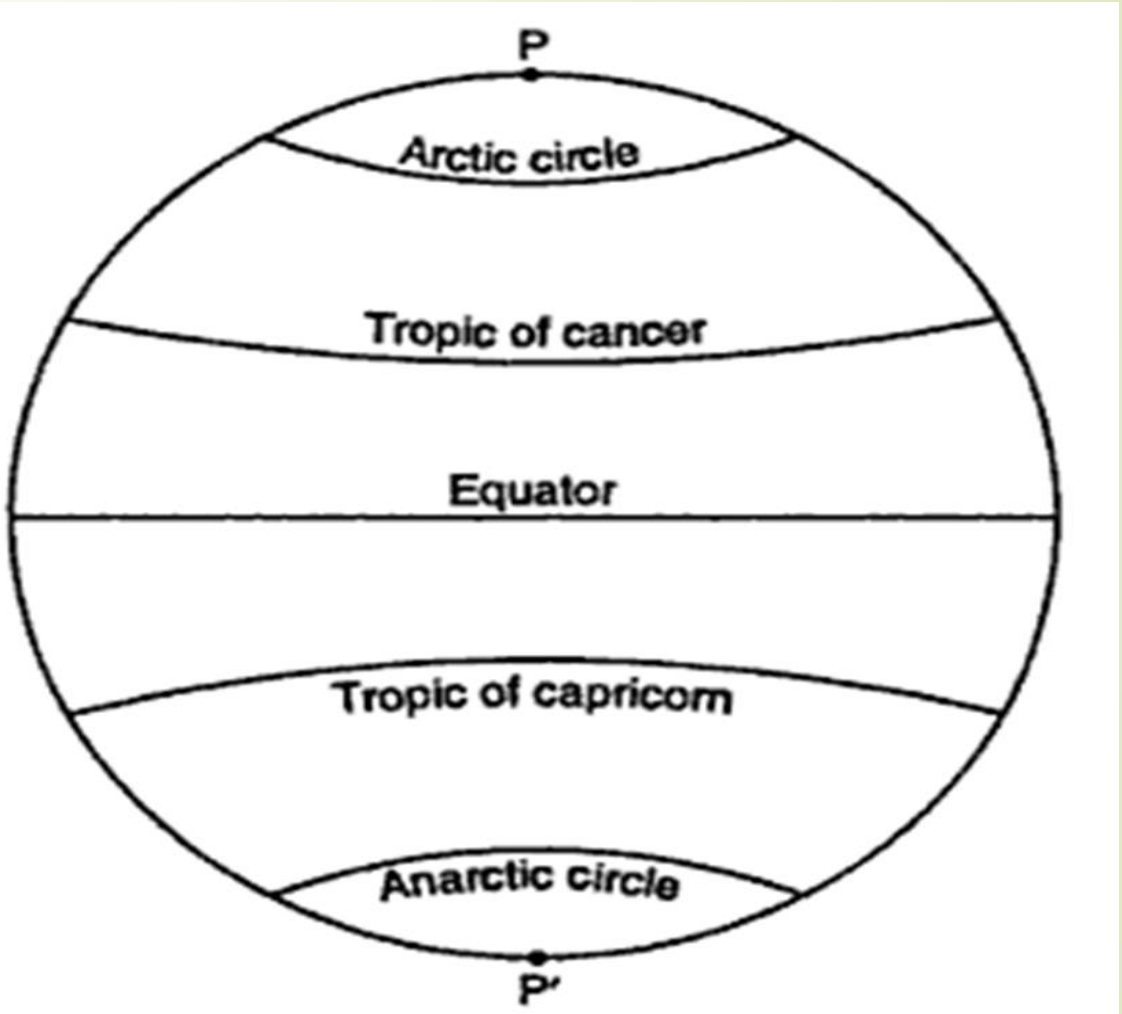


FIG. 1.12. THE ZONES OF THE EARTH.

ZONE OF EARTH

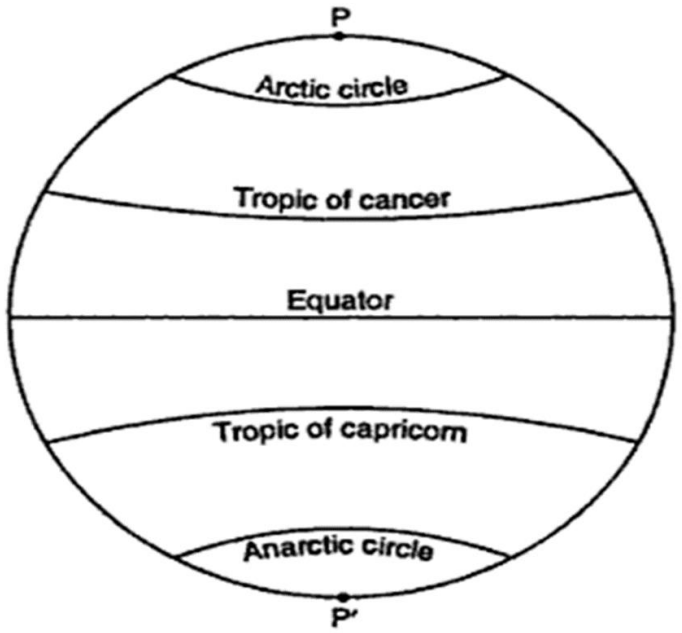


FIG. 1.12. THE ZONES OF THE EARTH.

Arctic Circle/Antarctic Circle

- Arctic Circle parallel that is normally positioned at 66° 33′ 46″ in the Northern/Southern Hemisphere.
- **Fluctuates by about 49 ft each year** due to the Earth's axial tilt.
- Fluctuation has been found to be at a rate of 2° every 40,000 years.
- Called the **North/South Frigid Zone** is characterized by extremely cold temperatures and ice.
- **During the winter**, the region experiences **24 hours of darkness** in a day and **24 hours of sunlight** in a day during the summers

Tropics of Cancer/Capricorn:

- A Circle of Latitude currently **positioned at** 23°26′14″ **North/South of the Equator.**
- Tropic of Cancer/Capricorn is the **Northern/Southern Tropic**.
- Northern Tropic at which the **Summer Solstice occurs** when once a year the sun appears directly overhead the most northerly parallel.
- This event happens in the **month of June**.
- Southern Tropic, at which the **Winter Solstice occurs** when once a year the sun appears directly overhead the most southerly parallel.
- This event happens in the **month of December**.

Thanks