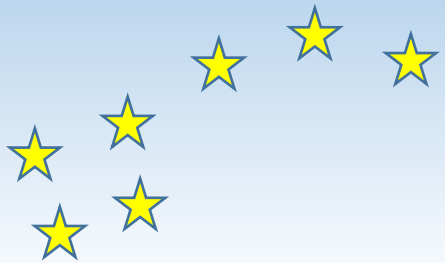


Introduction to the Sky

Physical Sciences
Broward College

Prepared for AST 1002

Horizons in Astronomy

What is a Constellation?

- Constellations are apparent star patterns in the sky.
- Constellation patterns were based in mythology, so each culture had their own set of constellations.
- Constellation patterns are consistent set (88 in all) throughout the world.
- Constellations are different from star clusters which are gravitationally bound set of stars.
- Ancient astronomers used altitude and azimuth to map the sky.

Altitude and Azimuth

- Altitude: The angular distance from the horizon up to the object.

- Azimuth: The angular distance from due north clockwise along the horizon to the object.

Angular Distances using your Hands

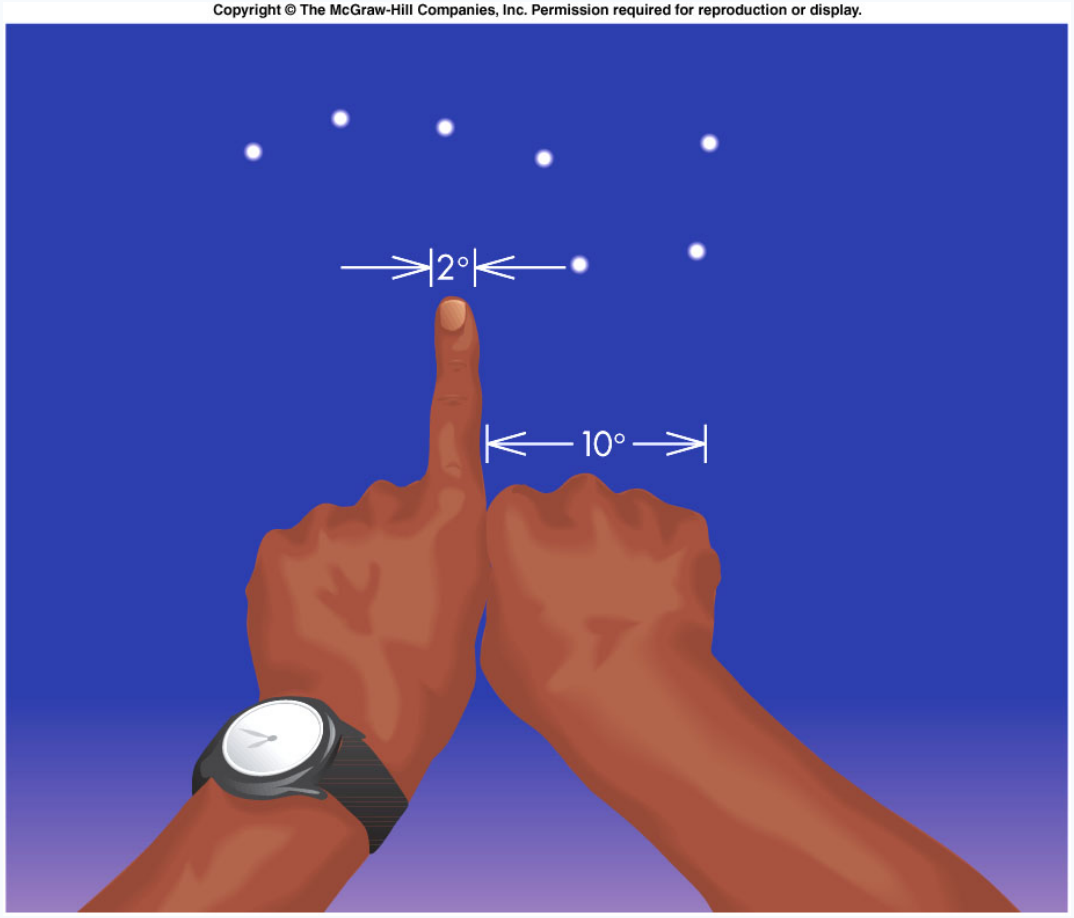


Figure 1. Hand Angles (Fix, 2004)

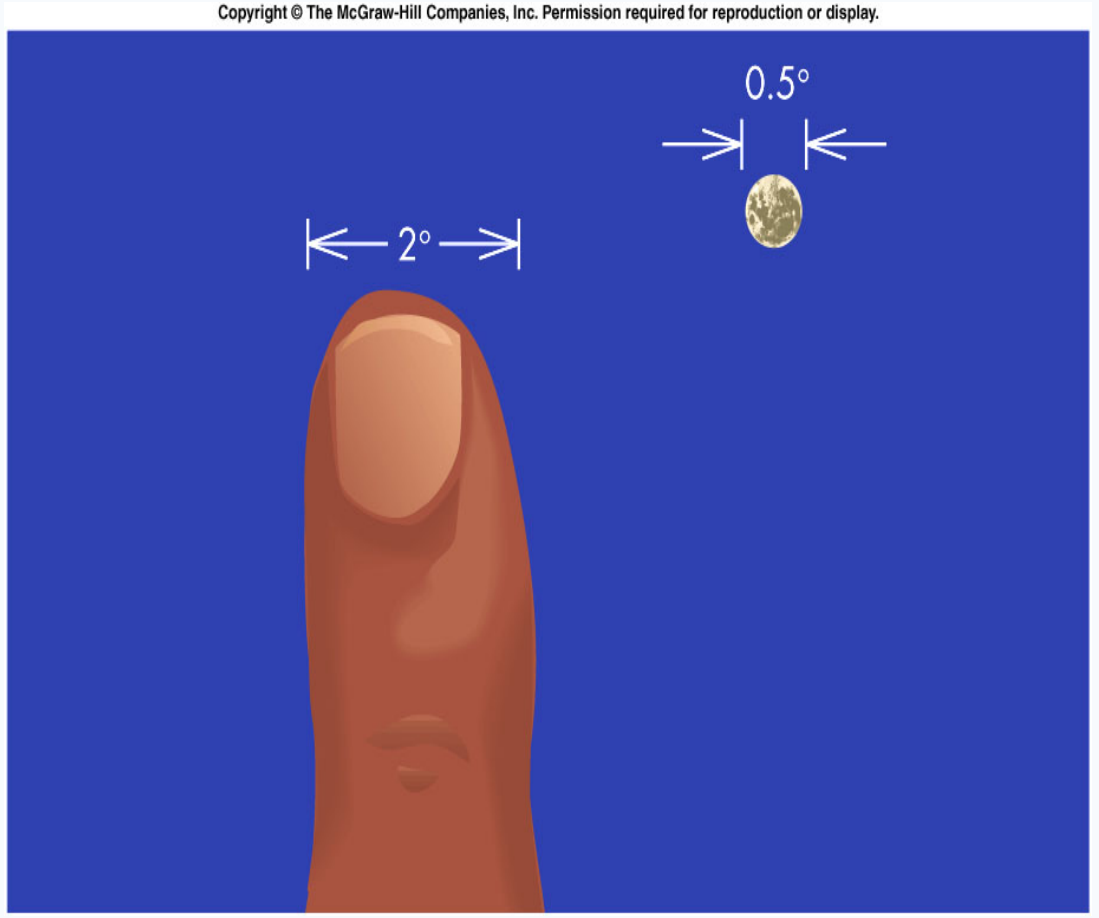


Figure 2. Finger Angles (Fix, 2004)

Angular Distances

- Degrees, Minutes, Seconds
  - 1° = 60’
  - 1’ = 60”
- Hours, Minutes, Seconds
  - 1 hour = 60 min = 15°
  - 1 min = 60 sec
- Your hand equals 10 degrees in the sky.

Angular Motion Example

- The orbital period of the Moon is 27 days. What is its relative speed to the stars in ◦/day? In ◦/hour?

$$v = \frac{d}{t}$$

$$v = \frac{360^{\circ}}{27\ days} = 13.33\,°/day$$

$$v = \left(\frac{13.33^{\circ}}{day}\right)\left(\frac{1\ day}{24\ hours}\right) = 0.56\,°/hour$$

The Celestial Sphere

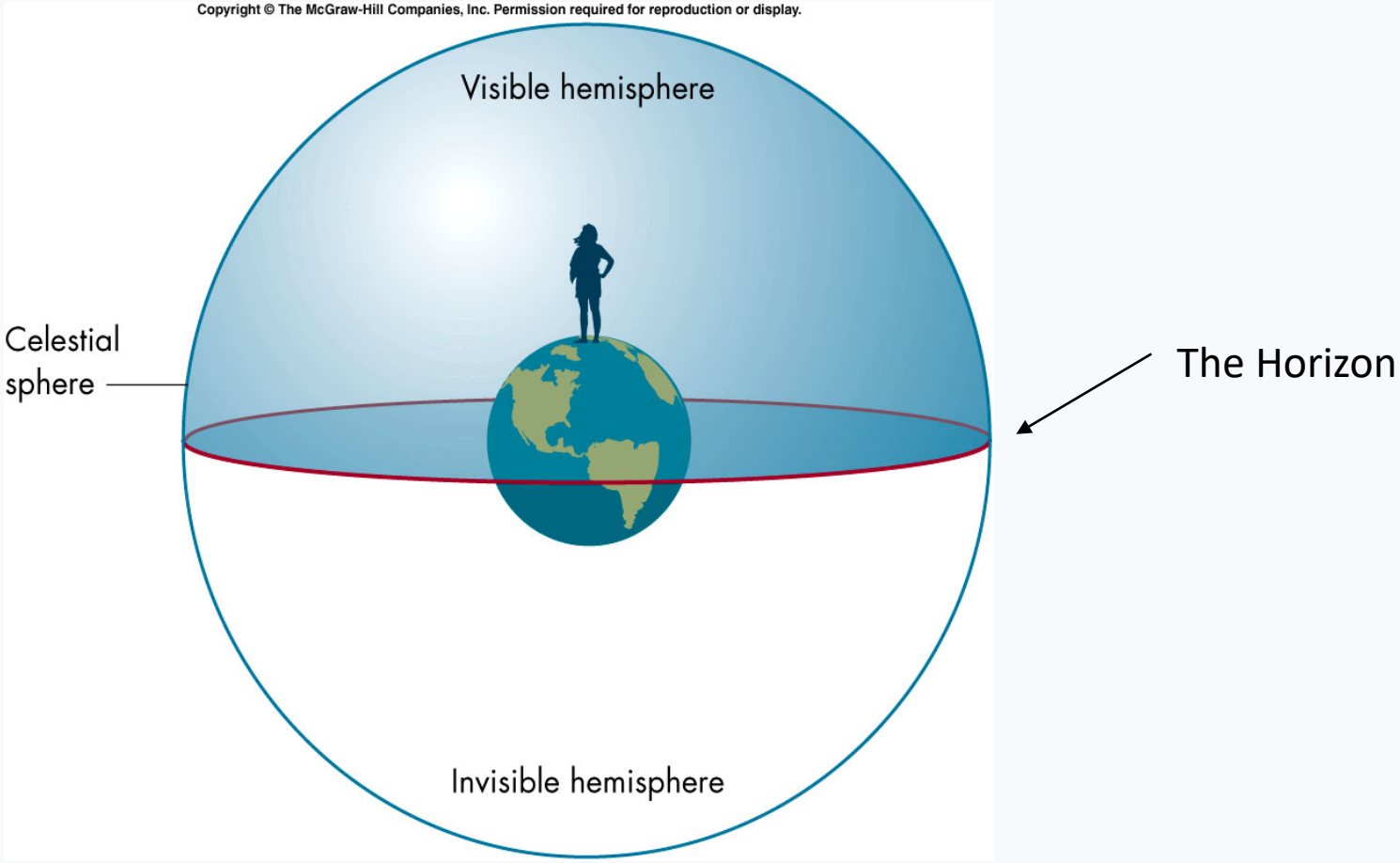
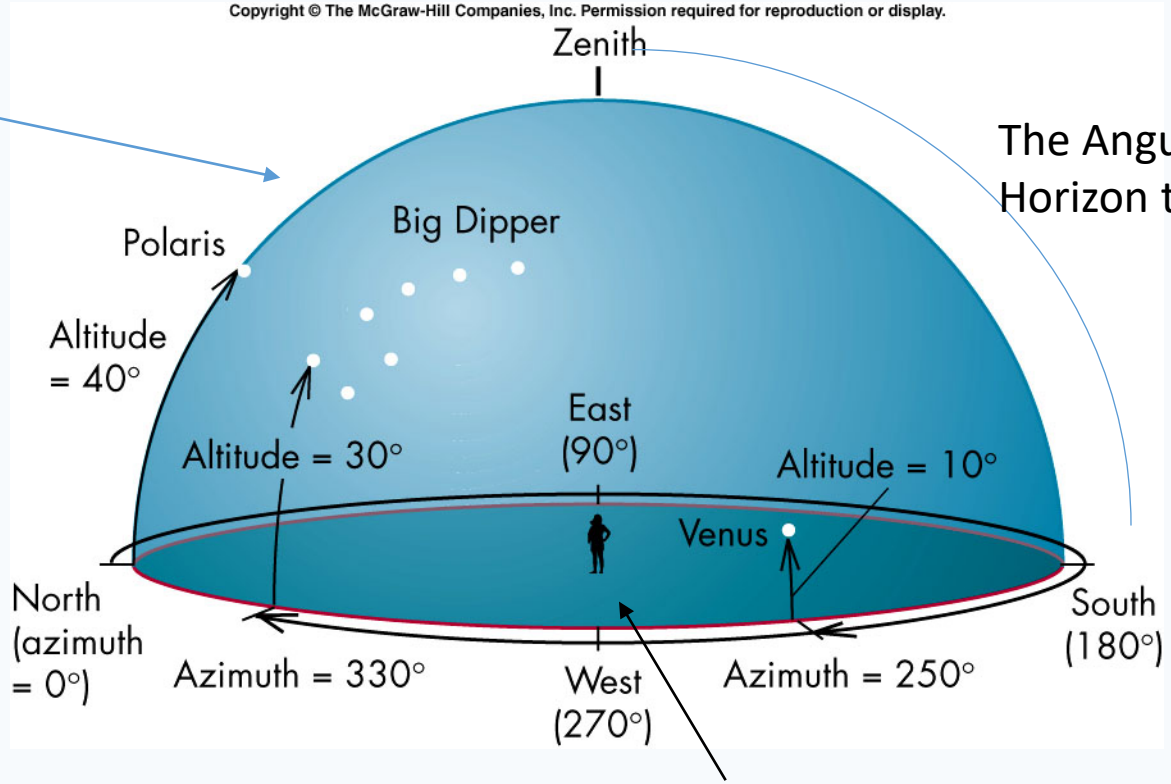


Figure 3. The Celestial Sphere (Fix, 2004)

The Visible Hemisphere

Meridian – Line that divides the sky between east and west.

Ancient astronomers used altitude and azimuth to locate stars in the sky.



The Angular Distance from the Horizon to the Zenith is 90 degrees.

Figure 4. The Visible Hemisphere (Fix, 2004)

Diurnal Stellar Motion in the Sky

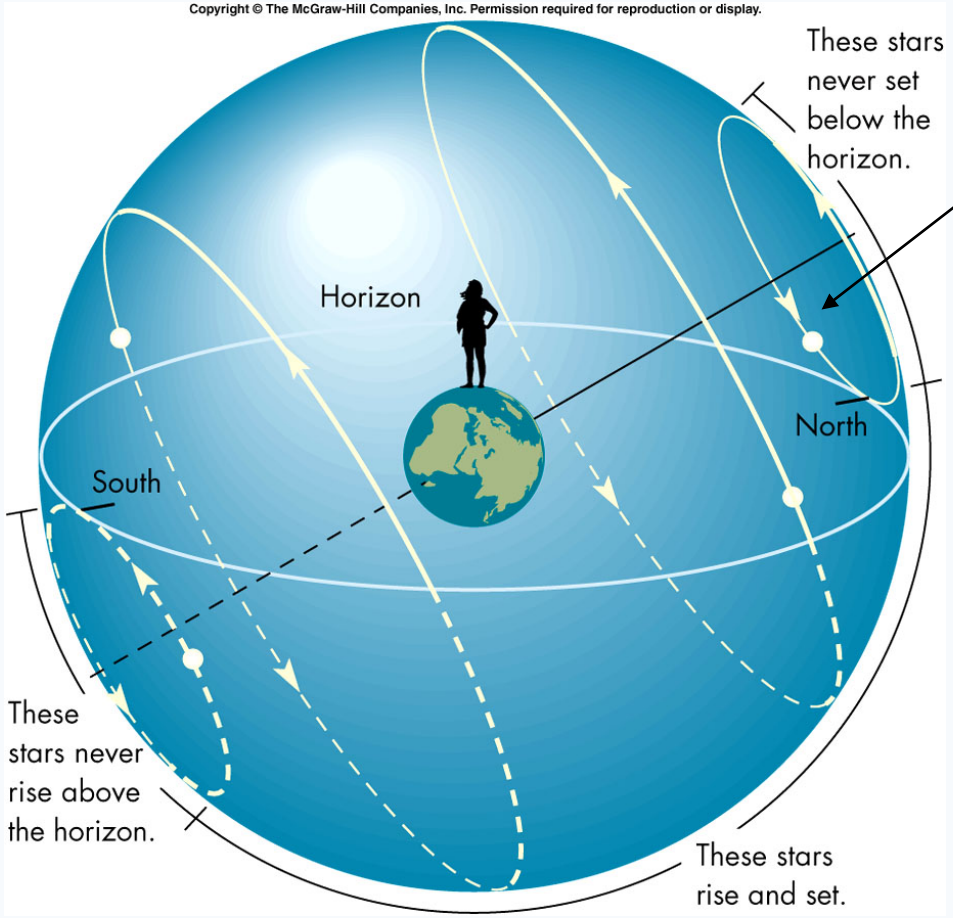


Figure 5. Motions in the Sky (Fix, 2004)

- Circumpolar Stars: Orbit the North or South Celestial Poles; do not set or rise.
- Rises in the east, sets in the west.
  - Azimuth always increases through the night (westward movement).
  - Altitude increases until meridian, then decreases until horizon (arc movement).

Annual Stellar Motion in the Sky

- We see different constellations in the sky during the year due to the Earth orbiting the Sun.
- Some constellations rise with the Sun and they are not visible because the Sun is brighter than the far away stars.
- Due to this motion, altitude and azimuth were supplemented with a more precise set of coordinates: right ascension and declination.

Right Ascension and Declination

Terrestrial Coordinate System

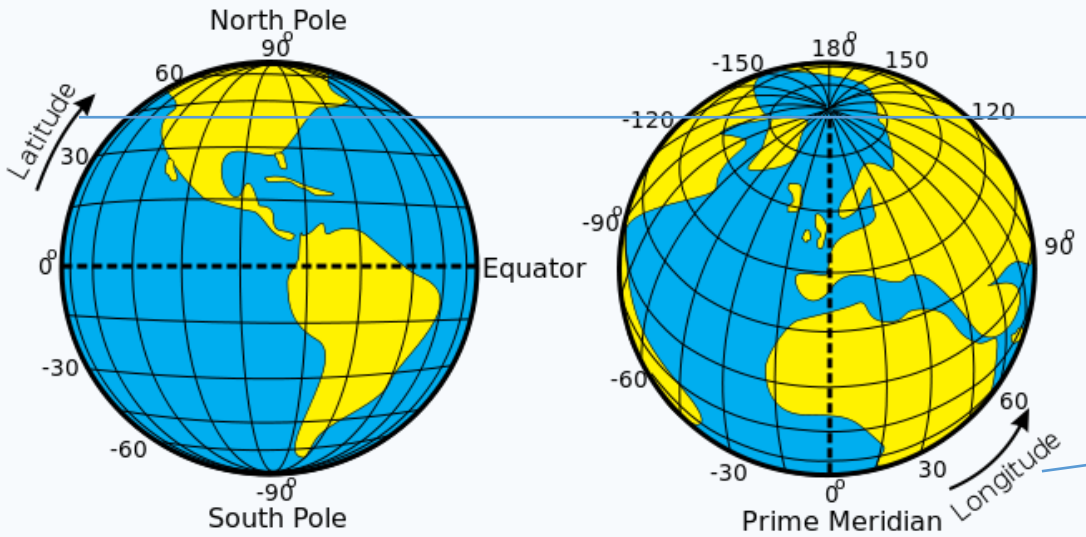


Figure 6. Terrestrial Coordinate System (Wiki)

Celestial Coordinate System

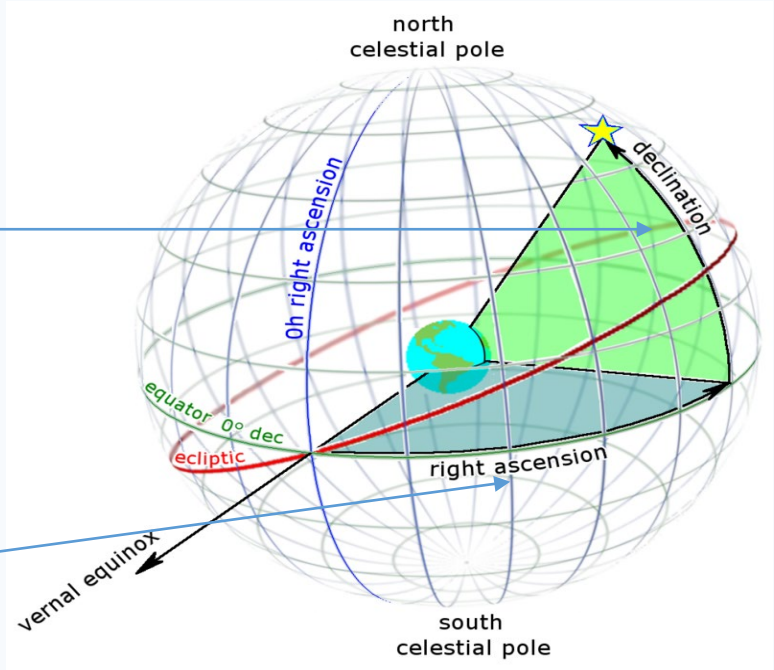


Figure 7. Celestial Coordinate System (Wiki)

Star Charts

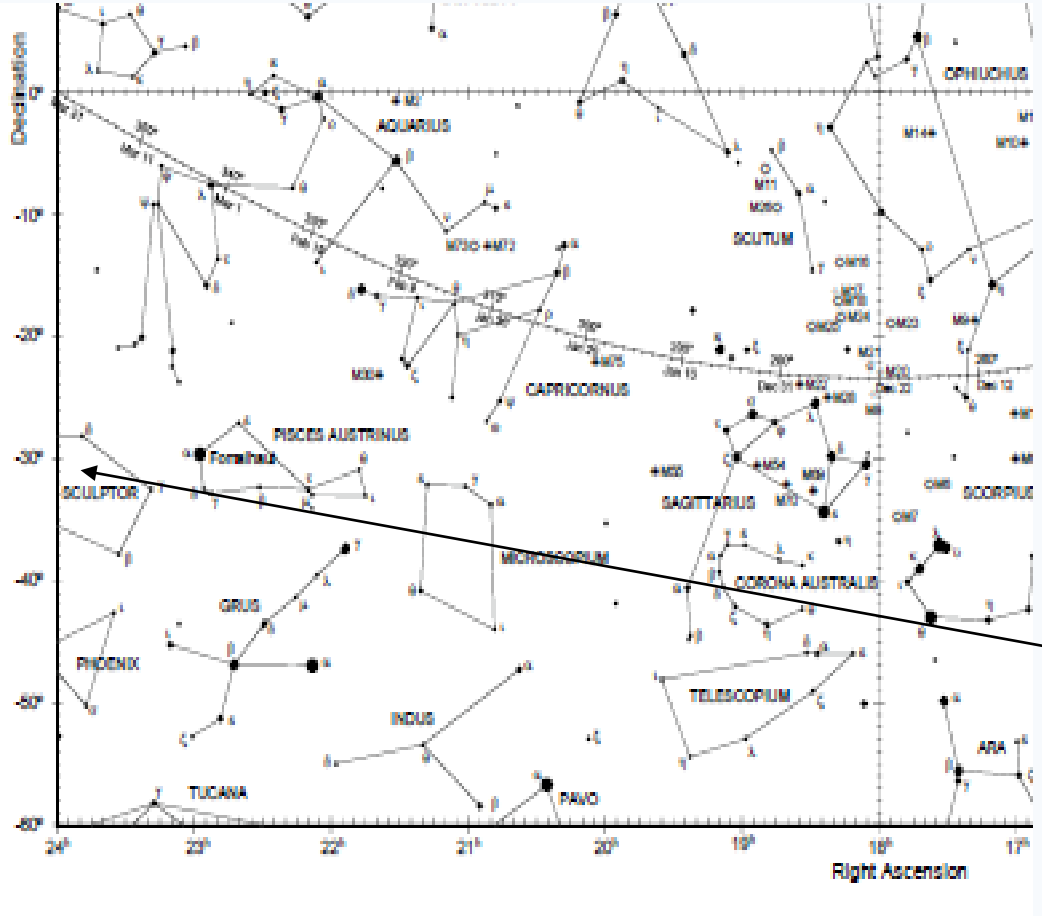


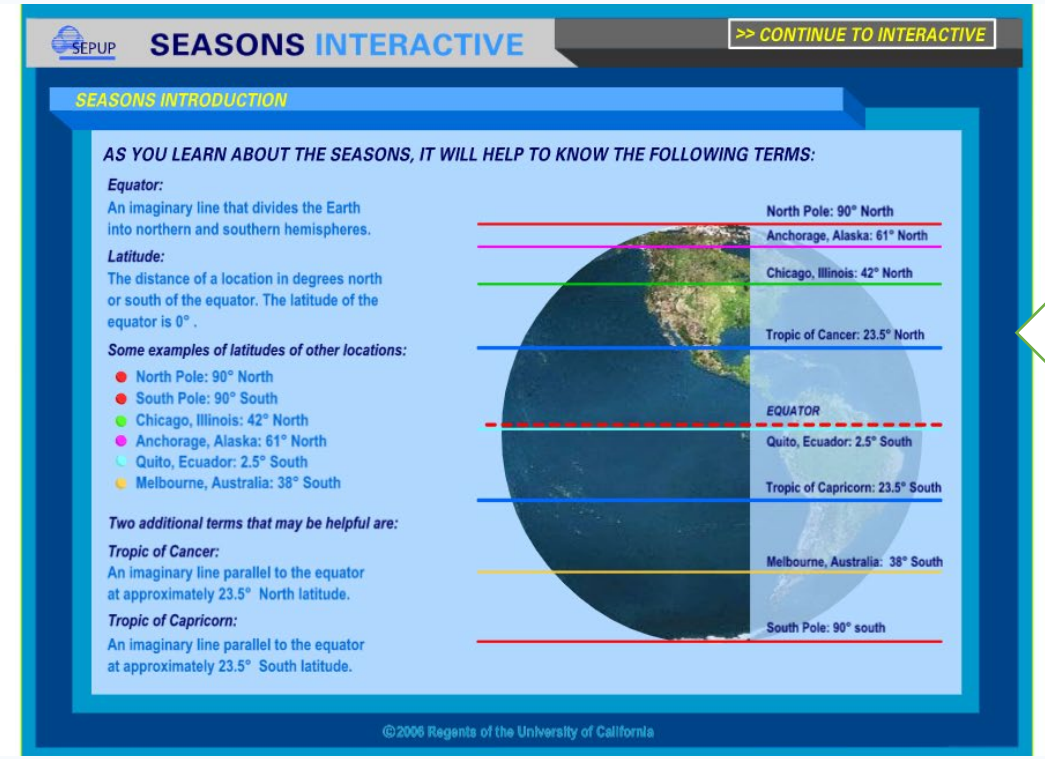
Figure 8. Star Chart (Bruton, 2015)

- Right Ascension and Declination are represented like Latitude and Longitude on a flat star chart.
- We can see where the stars are and where we can see these stars in the sky.
- Declination is in degrees, minutes, and seconds. Right Ascension is in hours, minutes, and seconds.
- This part of the sky is in in the south as indicated by the negative declination and covers half the sky on a particular night.
- The International Astronomical Union (IAU) in Paris, France is charged with all the naming constellations, stars, planets, minor bodies, and galaxies.

Solar Motion in the Sky and Precession

- The Sun travels along the ecliptic.
  - Due to the tilt of the Earth (23.5)
  - The Sun rises and sets at different positions each day.
- The Sun's annual motion is slightly faster than the rest of the stars.
- The Sun moves 2 hours in Right Ascension each month, which is called Sidereal Time
- The Earth wobbles on its axis and the position of the Sun with respect to the stars changes; it is called precession.

Earth Orbiting the Sun

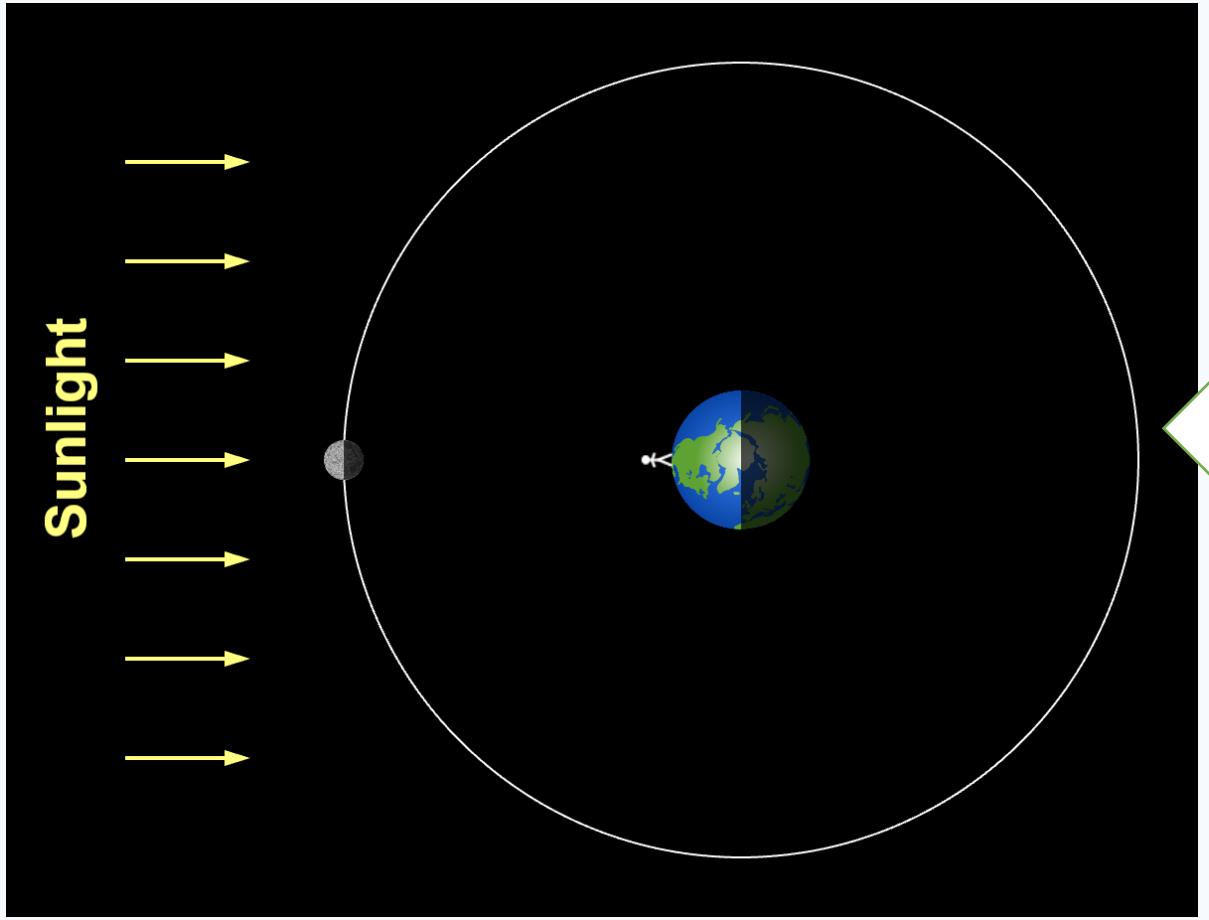


Click here

Motion of the Moon

- The Moon has its own path around the sky due to a tilt of its revolutionary axis.
- The Moon has phases (new, crescent, quarter, gibbous, and full) due to amount of sun light reflecting off the moon.
- The Moon's synodic period (phase time) is longer (29.5 days) than its sidereal period (time of orbit, 27 days)
- Solar/Lunar Eclipses occur when a line of nodes occur.
  - Lunar: When the Earth blocks sunlight from the Moon. Occurs when the Moon is in its Full phase.
  - Solar: When the Moon blocks sunlight from the Earth. Occurs when the Moon is its New phase.

Phases of the Moon



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Solar/Lunar Eclipses

When the nodes align; there is an eclipse.

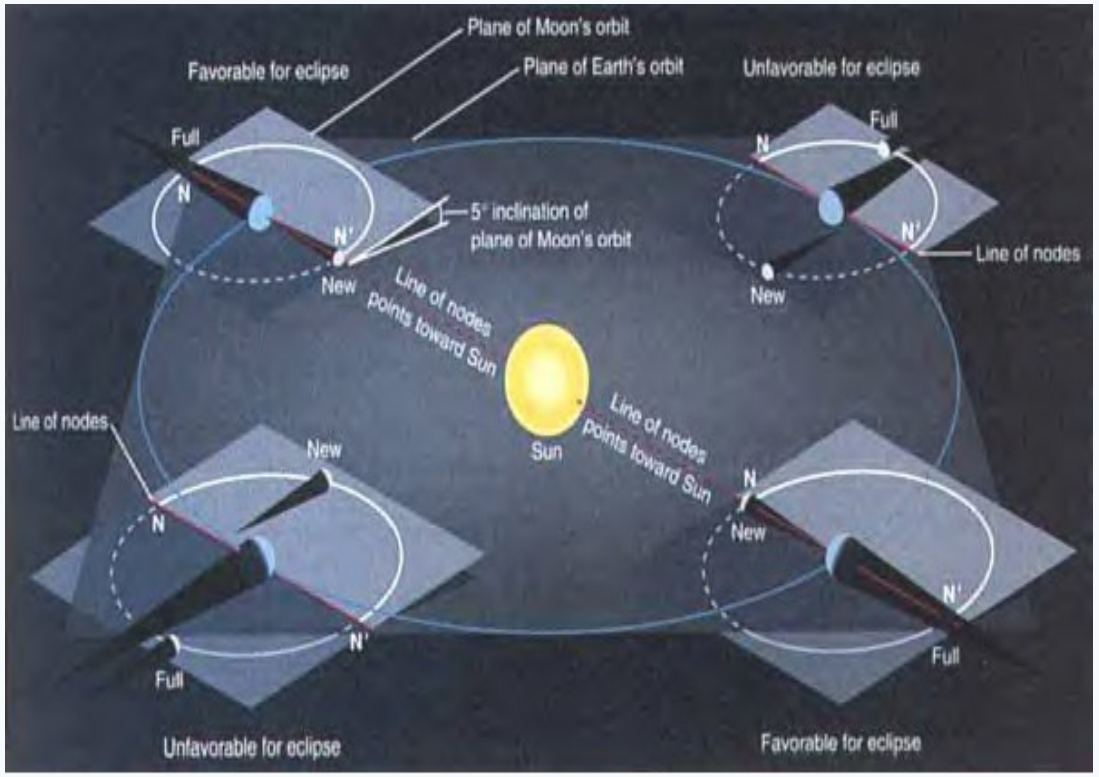

Figure 9. Line of Nodes (Blanco, 2004)

Types of Eclipses

Type	Shadow Location
Full	Umbra
Annular	Umbra/Penumbra Intersection
Partial	Penumbra

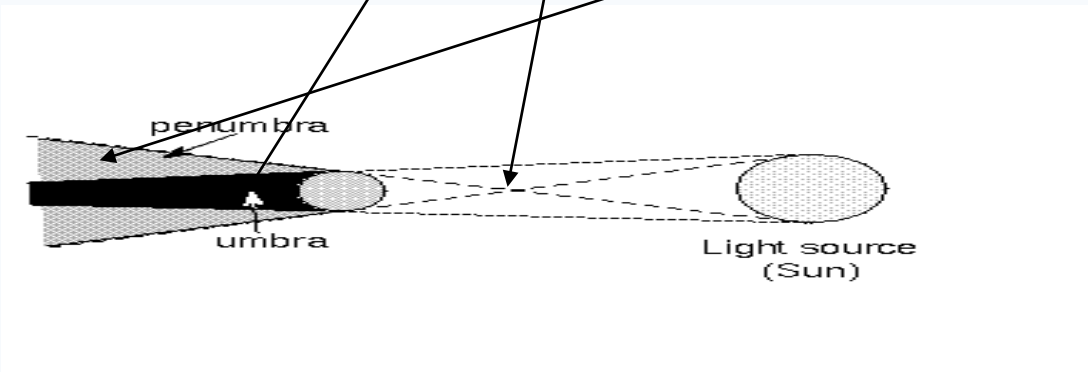

Figure 10. Penumbra/Umbra (Strobel, 2014)

Eclipses

Total Lunar Eclipse

Figure 11. Total Lunar Eclipse (Van Werven, 2004)

Partial Solar Eclipse

Figure 12. Partial Solar Eclipse (Van Werven, 2004)

Motions of the Planets.

- The planets travel around the ecliptic.
- The planets seem to go backwards in comparison the stars in some parts of their orbit because the Earth passes the planet in its orbit. This is known as retrograde motion.
- The planet's name means "wanderer" in Greek.

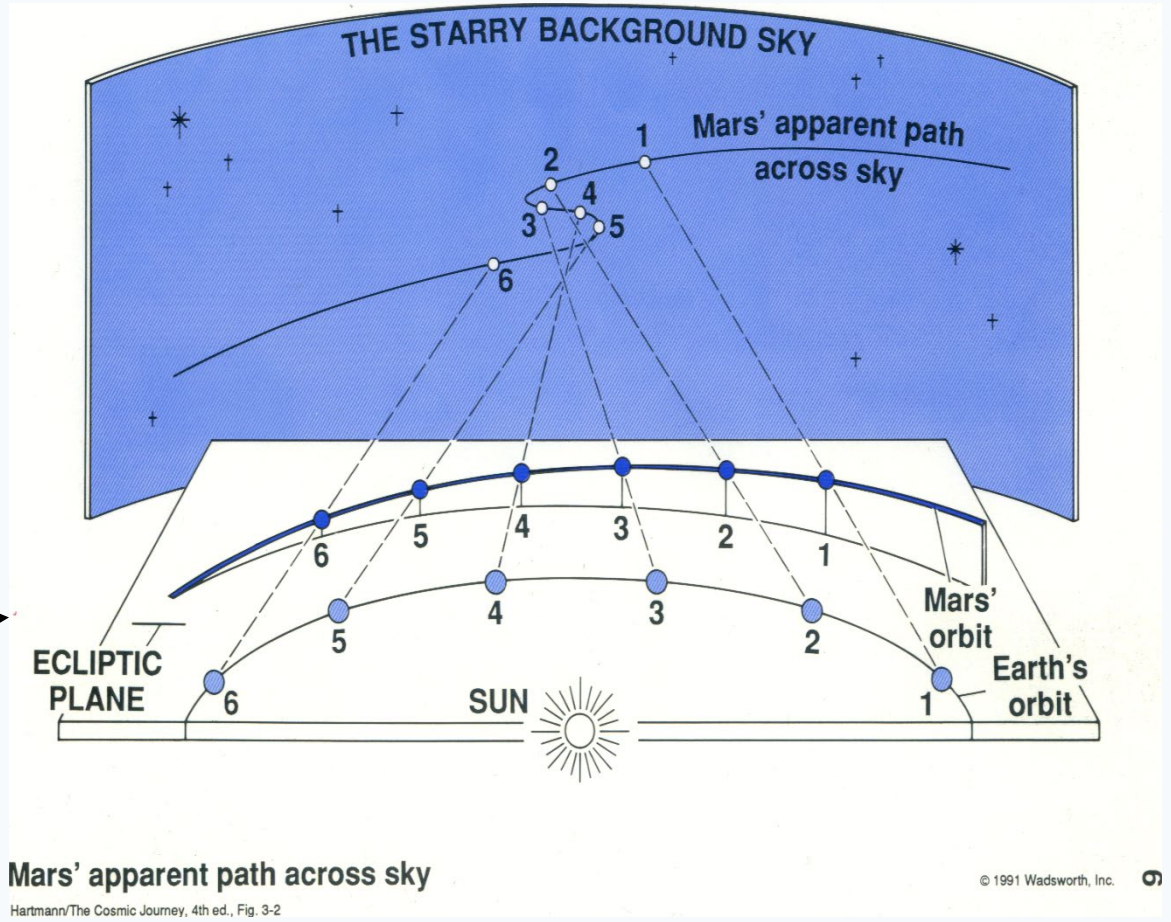

Figure 10. Retrograde Motion (Hartmann, 1989)

Book/Course Image References

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