Stars, Galaxies & Universe Announcements

- No labs this week!
-Add/drop issues to be taken care of in main office: 203 VAN
- All clickers in the bookstore will work in class (there is an updated clicker and an old clicker for sale).
- Textbook is useful resource, but class notes should guide your learning (we won't cover everything in text book!)

- First ***reading quiz***: Monday (8/30)

- First ***homework*** in ICON should be completed between 8/26 (Thurs) and 8/30 (Mon)

Clicker Frequency Setting

1. Hit "Channel" button

2. Hit 44

Light should be flashing Red/Green while setting

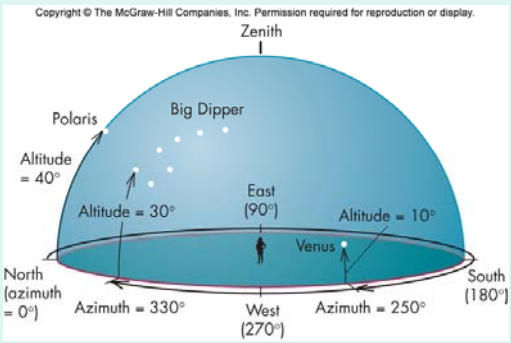
3. Press "Channel Button"

4. Light should settle on green if the setting worked

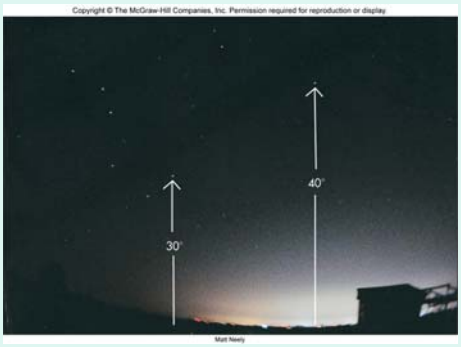
Lecture 2 Outline

- Review of celestial sphere
- Sky from different positions on Earth
- Daily Motion (Motion #1)
- Annual Motion (Motion #2)
- Seasons

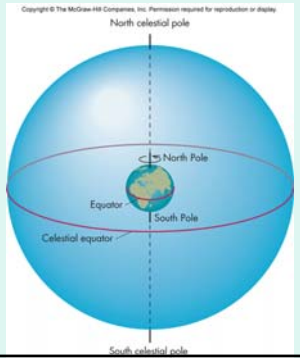
Coordinates in the Night sky: Horizon System



The **altitude** of Big Dipper star and Polaris

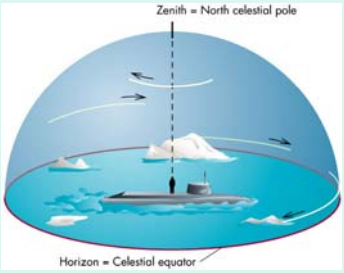


Celestial Sphere: Extension of the Earth's Coordinates



The Night Sky at the North Pole

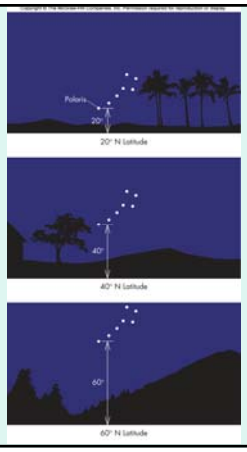
Polaris (N. Celestial Pole) fixed overhead
Other stars move westward on horizon
Can not see the "southern celestial sky"



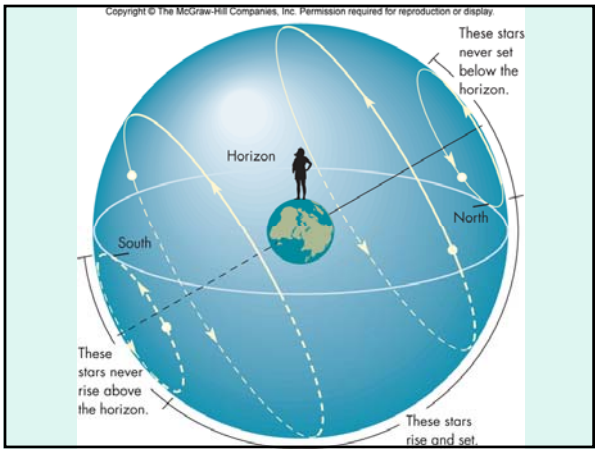
Night Sky at the Equator

The Night Sky near the Equator

Most of us are in between these extremes
we see fixed Polaris (N. Celestial Pole star)



The **altitude** of Polaris is the same as the observer's **latitude**

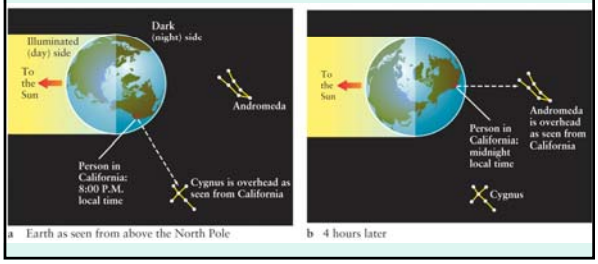


What is responsible for the motion of the stars each night?

Motion #1: Diurnal Motion

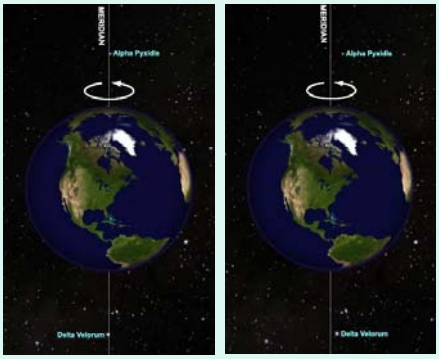
Motion of Earth on its axis = ~24 hours (23h 56m 4.1s)

- stars, sun, planets appear to move WESTWARD (rise E, set W)
- constellations normally "fixed" in the sky
- Earth's motion causes constellations to "rise", "set"



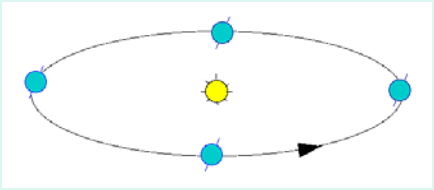
Earth's rotation=not exactly 24hr period - 4 minutes extra

- amount of time between a star reaching the same position (meridian) on two sequential nights: 4 minutes; star will "rise" 4 minutes earlier each nt.



Motion #2: Annual motion

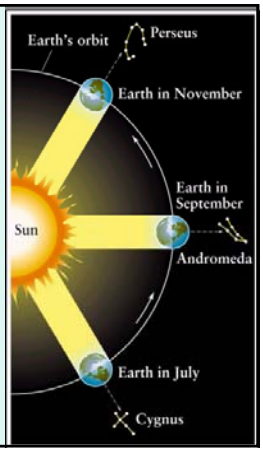
- Earth travels around the Sun in 1 "year" – 365 "Earth days"
- orbit is not quite a perfect circle (ellipse)
- depends on the size of the orbit around the Sun (distance)
  - Mars ~ 1.9 "Earth years"
  - Mercury ~ 88 "Earth days" ~ 0.25 "Earth year"
  - Pluto ~ 250 "Earth years"



perspective "off" of the Earth – also orbit's eccentricity highly exaggerated!

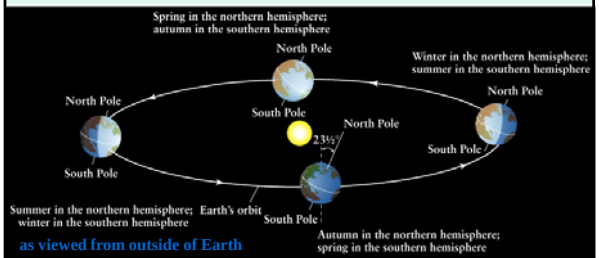
As Earth orbits our Sun, different constellations are visible at different times of the year.

- *The circumpolar constellations (i.e. the ones around Polaris) are always the same because they are visible no matter where Earth is in its orbit.*
- *Constellations are essentially "fixed" relative to our motions*



More complex: Earth is tilted 23.5 degree tilt on its axis

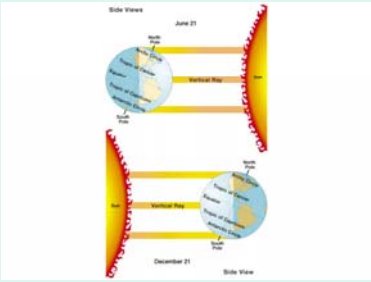
- "axis" runs through the N and S poles
- tilted with respect to the Earth's orbital plane
  - **N. Summer**: N. hemisphere tilted *toward* Sun
  - **N. Winter**: S. hemisphere tilted *toward* Sun



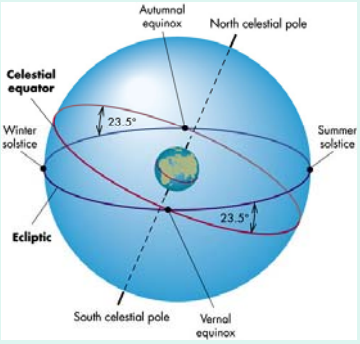
The DIRECTNESS of the rays is what causes the seasons to occur

- summer (N. Hemisphere) – more VERTICAL RAYS
- winter (N. Hemisphere) – fewer VERTICAL RAYS

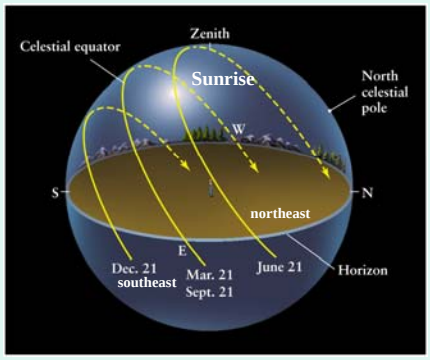
Fact 1: Earth-Sun distance only changes by 3% over the year
Fact 2: Earth is actually closest to the Sun during January!!

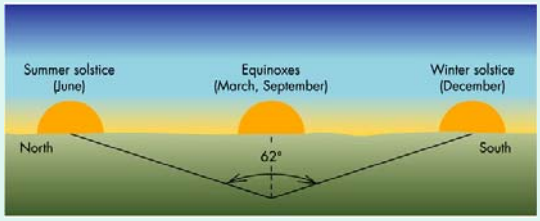


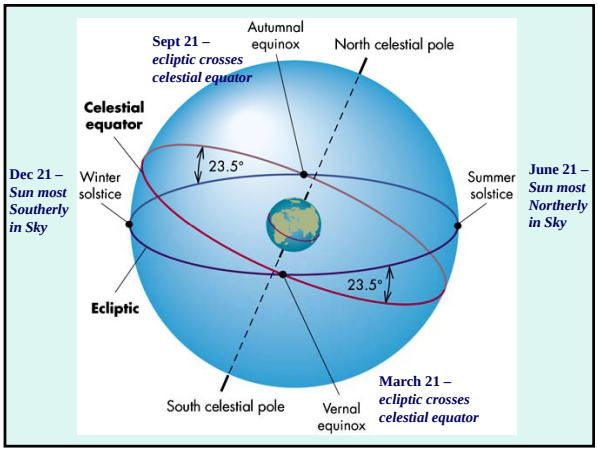
Ecliptic: *apparent* path of the Sun in the sky
makes a 23.5 degree angle with celestial equator

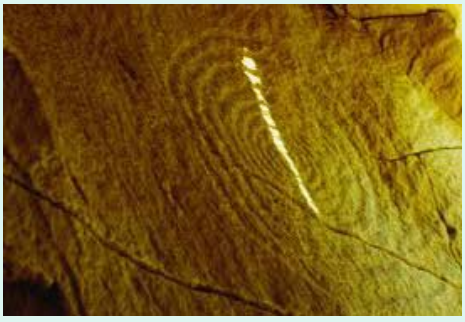


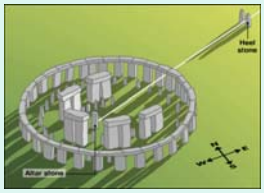
"On Earth", we observe changes over the course of the year due to the tilt of the Earth on its axis



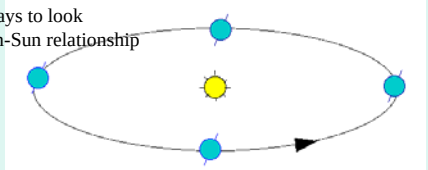

Summer solstice
(June)
Equinoxes
(March, September)
Winter solstice
(December)
North
62°
South

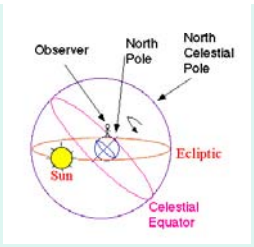

Autumnal
equinox
North celestial pole
Sept 21 –
ecliptic crosses
celestial equator
Celestial
equator
Dec 21 –
Sun most
Southerly
in Sky
Winter
solstice
23.5°
Summer
solstice
June 21 –
Sun most
Northerly
in Sky
23.5°
Ecliptic
March 21 –
ecliptic crosses
celestial equator
South celestial pole
Vernal
equinox

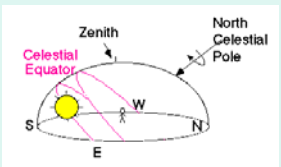




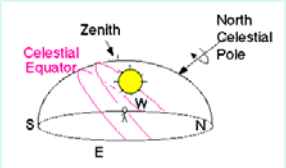
Two ways to look
at Earth-Sun relationship







N. Hemisphere winter:
ecliptic (sun) south
of celestial equator



N. Hemisphere summer:
ecliptic (sun) north
of celestial equator