

## Getting Oriented: Astronomical Coordinate Systems

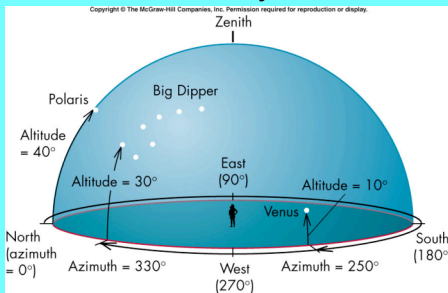
- Why are we doing this?
- Lecture material for next week's lab
- Basis for many important technological accomplishments (Pyramid of Cheops)



## The basic idea

- Express the position in the sky of an astronomical object in terms of numbers
- One part of the Greek concept that there is a mathematical basis to nature

## First reference system: the Horizon System



Two coordinates: altitude and azimuth

## Coordinates in the horizon system

- Altitude angle goes from 0d to 90d
- Azimuth angle goes from 0d to 360d

## In Horizon System, we see motions in the sky

- The Sun rises in the east, reaches highest altitude angle due south, sets in the west
- When the Sun sets, it gets dark and we see the stars and planets
- The Moon “ “ “ “
- The Moon rises at a different time each night and is seen against a different constellation
- The constellations in the evening sky are different in different seasons



## Fundamental astronomical observation:

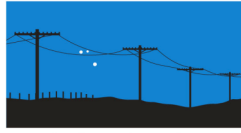
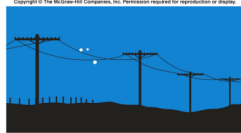


The rising and setting of the Sun. Most people don't realize other astronomical objects do this as well

## Question for the audience:

What is going on to cause this east-to-west motion of all objects, rising in east and setting in west?

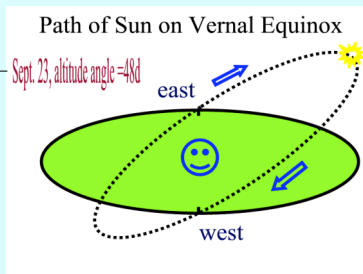
Demo →



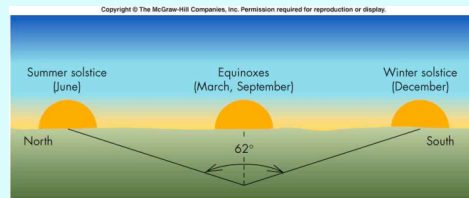
There are other aspects of the night sky (and daytime sky) that are not obvious to modern people

## Seasonal Variations in the Position of the Sun (back in horizon system)

This year, September 22, 10:09 PM



## The changes in the rising (and setting) locations of the Sun are big



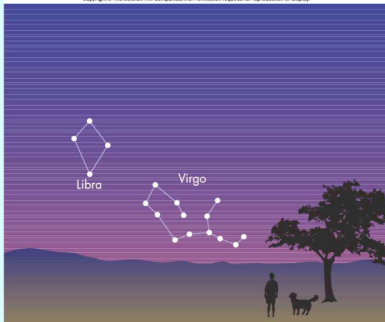
## Seasonal differences in the night sky: go out tonight at 9 PM

- Constellations Bootes in west
- Bright star Vega straight overhead
- Constellation of Scorpius (with bright star Antares) low in southwest.
- Constellations of Pegasus and Andromeda just rising
- Check it out with the help of star charts!

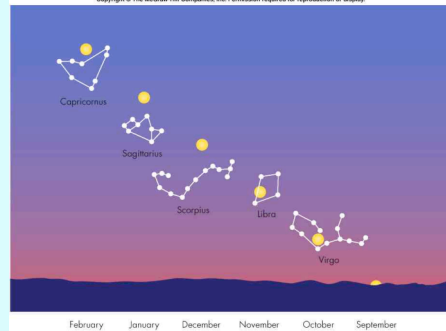
By the end of the semester, the situation will be entirely Different.

There is a phenomenon that could be called the "Parade of the Constellations"?

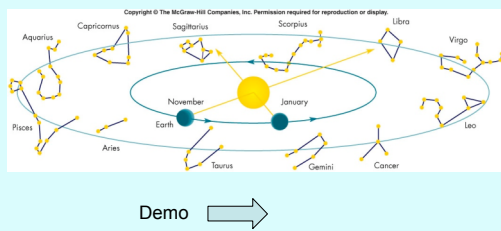
### Measuring the position of the Sun against the background stars



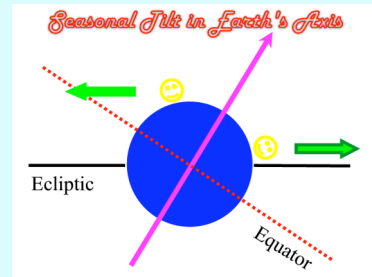
### The path of the Sun through the stars



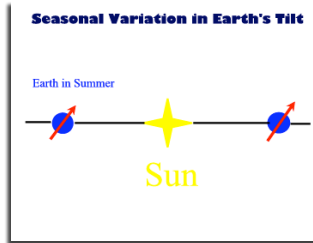
### The "parade of the constellations"



### Obliquity of the Ecliptic and the Altitude Angle of the Sun

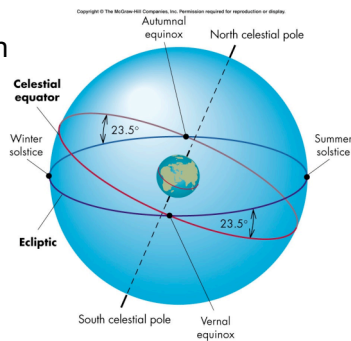


### Explanation of Seasonal Variations: tilt of the Earth's axis: *obliquity of the ecliptic*



### Two Lines on the Sky

- The ecliptic
- The celestial equator
- See Figure 2.11



For new purposes, we need a different coordinate system

Analogy: I am riding my bike on a dirt road near Lone Tree, and want to describe to someone in London the location of a radio tower I see in the distance.

Question: what system of coordinates do I use?

## A New Coordinate System: Celestial Coordinates

- The stars “stick together” and define their own reference system. The planets move with respect to them
- Celestial coordinates are Right Ascension and Declination
- Right Ascension ..... Longitude ←
- Declination ....latitude ←
- <http://sohowww.nascom.nasa.gov/>