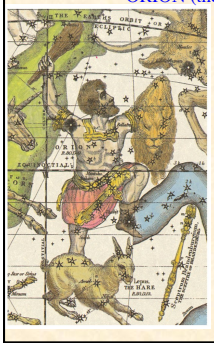
- LAST TIME: Celestial Geography
  - Spherical Geometry
  - Altitude & Azimuth
- TODAY: Daily Motion of the Sky
  - Latitude and Longitude
  - Right Ascension and Declination
  - Annual Motion of the Sky; Apparent Solar Motion
- WEDNESDAY: Longer Term Variations & Time
  - Celestial Measurements of "Time"
  - Long-Term Variations: Parallax and Nutation
  - Other Factors Affecting Position and Time Measurements

Location in the Sky. II. "Geographic"

- CONSTELLATIONS - names given to patterns of stars in the sky
- now defined in terms of accepted boundaries
- how did they get their names?
- why constellations aren't a good way to describe location (at least not accurately)
- how are constellations used these days?

Eighty-eight constellations cover the sky

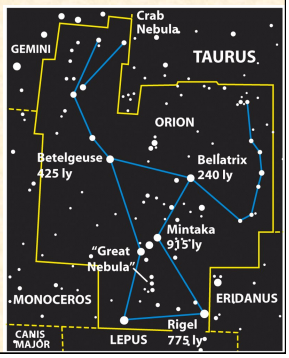
ORION (the hunter)



- Ancient peoples looked at the stars and imagined groupings made pictures in the sky
- Different patterns named by different cultures; modern names come from a variety of sources

Modern Constellations

- The entire sky is divided into 88 constellations; Internationally agreed upon names and boundaries
- Boundary lines drawn on the sky so that all stars are in only one constellation
- Different shapes and sizes; fit together like a jigsaw puzzle
- Many star names come from the constellation they are in (e.g. Alpha Centauri)
- Stars in constellation only *appear* to be close together, because they are in nearly the same direction as seen from Earth



Location in the Sky. III. "Global"

1. On Earth....

- **latitude**: angle from equator (+ = north)
- **longitude**: angle from prime meridian (east or west)

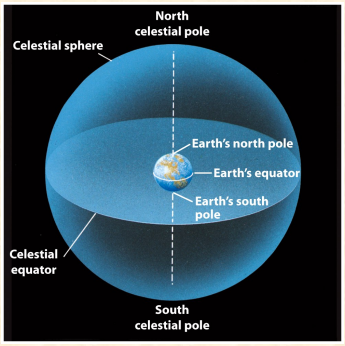
Analog: azimuth and elevation viewed from center of Earth

Charleston: 32° 46' 35" North & 79° 55' 53" West

- How do we put a similar grid on the sky?
- We first need a POLE and EQUATOR ...

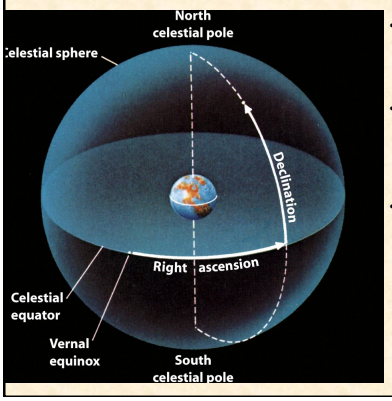
The "Celestial Sphere"

- The celestial sphere is an *imaginary* construct
- But it is a useful tool
- "Landmarks" on the celestial sphere are projections of those on the Earth



2. On the Sky...

- **RIGHT ASCENSION**. Celestial longitude. Lines of constant RA perpendicular to celestial equator, and all pass through celestial poles. Measured in HOURS (0-24; 24 hours=360 degrees; so 1 hour = 15 degrees). [which direction? from where?]
- **DECLINATION**. Celestial latitude. Lines of constant DEC parallel to equator. Measured north (+) or south (-) of celestial equator, like latitude on Earth.



- **Celestial equator** divides the sky into northern and southern hemispheres
- **Celestial poles** are where the Earth's axis of rotation would intersect the celestial sphere
- Polaris is less than 1° away from the north celestial pole, which is why it is called the **North Star** or the Pole Star.

Day Time v. Night Time

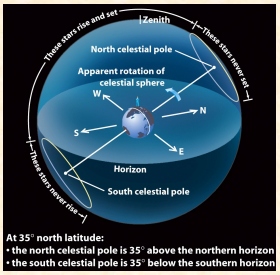
- Shine light on a sphere, and half of it is lit up
- Half of Earth in daylight; other half in nighttime
- Fortunately, we rotate so that we can share the Sun (but not equally for all parts of Earth, as we'll soon see)
- Earth ROTATES! How do we know when we've completed one rotation?
- 1 rotation = 1 day ≈ 24 hours

Rotation of the Earth

- Spherical Earth "rotates" once in 24 hours (it's actually $23^h\ 56^m$)
- Earth's rotation is from west to east (counterclockwise viewed from above north pole)
- Sky *appears to rotate* east to west once in 24 hours (opposite sense of Earth's rotation)
- "Axis" of rotation through north and south poles
  - projects to north celestial pole (NCP) and south celestial pole (SCP)
- Equatorial plane perpendicular to axis
  - cuts through our equator
  - projects to circle on the sky called the celestial equator (CE)

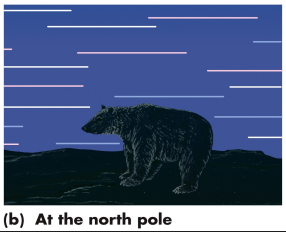
Apparent Daily Motion of the Sky

- path across the sky, and how long things are "up" depends on:
  - your latitude on Earth
  - object's declination
- some examples...



The Sky Viewed from the North Pole

- everything is up for 24 hours!
- everything moves in counterclockwise circle (looking up)
- motion is parallel to ground; elevation angle never changes


(b) At the north pole

- NCP at zenith
- CE along horizon
- always see the same stars: never see any stars in the sky's southern hemisphere

The Sky Viewed from the Equator

- everything is up for 12 hours!
- everything moves east to west in straight lines
- rise and set perpendicular to ground (it gets dark in a hurry!)

(c) At the equator

- NCP at horizon
- CE overhead: from east through zenith to west
- see all stars in BOTH hemispheres!

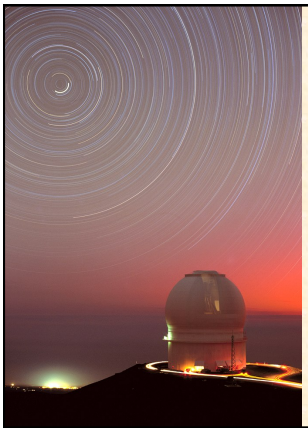
The Sky Viewed from Charleston

- motion depends on where in sky you are looking
- some apparent paths are east-->west arcs
- some apparent paths are counterclockwise circles
- time from rise to set depends on declination:

0^h: < -57°; $<12^h$: -57 to 0°; $>12^h$: 0-57°; 24^h >57°

(a) At middle northern latitudes

- NCP elevation=33°
- CE from east through meridian elevated by 57° to west
- see all stars north of declination -57°



- all stars move in ccw circles around NCP
- stars with declination more than 90 minus your latitude (57 to 90 degrees for Charleston) are "CIRCUMPOLAR"
- for stars south of this, we only see a portion of their circular path, so they appear to move in an arc
- notice that stars farther from pole move farther in same amount of time