The Sky From Earth

When we walk outside and look into the sky, what do we see?
How does our view change with time?
Why does the night sky change in the way that it does?

Lecture Tutorial: Motions in the Sky

4. How does the Sun move over time?

   5.How do the Planets move over time?

   6.How does my view change with position on Earth?

B.WHY do we see what we see?

   1.Why does the horizon block half the sky?

   2.WHY to questions A4 through A7

C. Miscellaneous Tidbits

   1.What causes the seasons?

   2.What is a Sidereal Day?

   3.What is a Solar Day?

What's the reason for the Seasons?

In class discussion… Take good notes.

Show beam spreading before tutorial
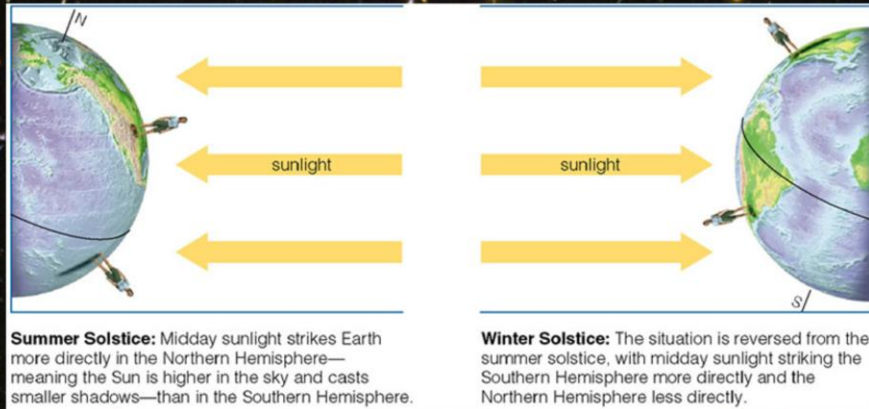
In class discussion… Take good notes.

Which of these are reasons for the seasons?

What's the reason for the Seasons?

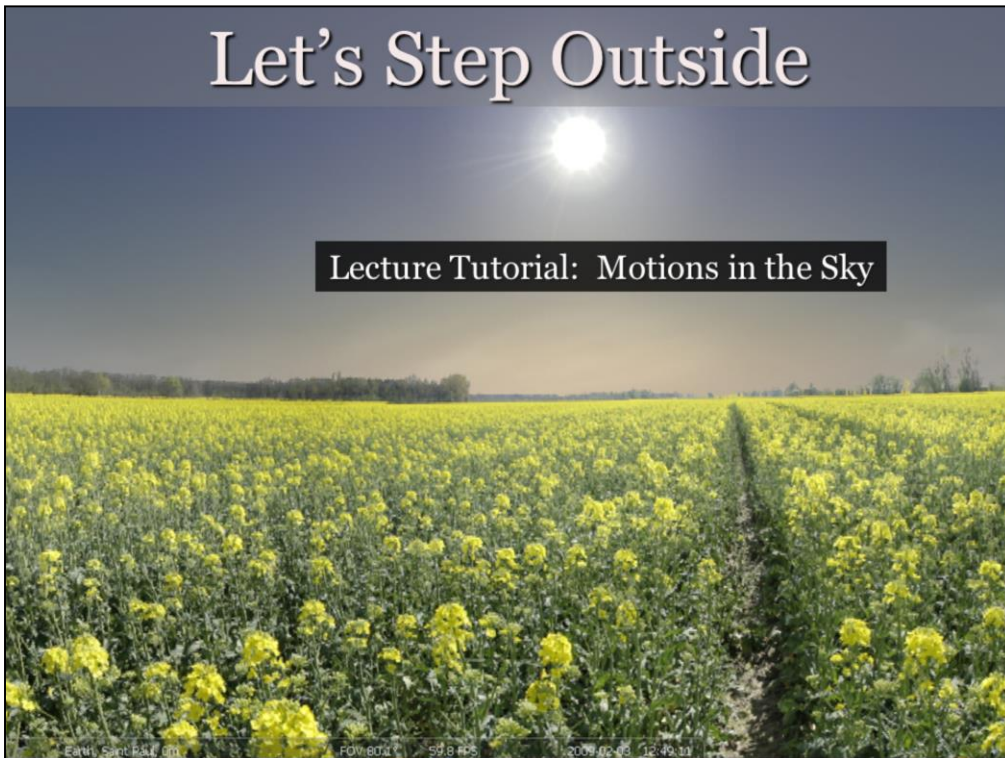In class discussion… Take good notes. Some of these are NOT correct!

What's the reason for the Seasons?

- Tilt causes more "direct" sunlight – in other words, more ENERGY per AREA falling on the surface – in summer, and less energy per area in the winter (this is called "beam spreading")
- Tilt also causes sun to be up LONGER during summer months (so there is more time for heating to occur)

Is it JUST the tilt? No – also the orbit of the Earth around the sun.

Using Stellarium, complete the lecture tutorial.

Motions in the Sky: one day

(star trails above Mauna Kea)
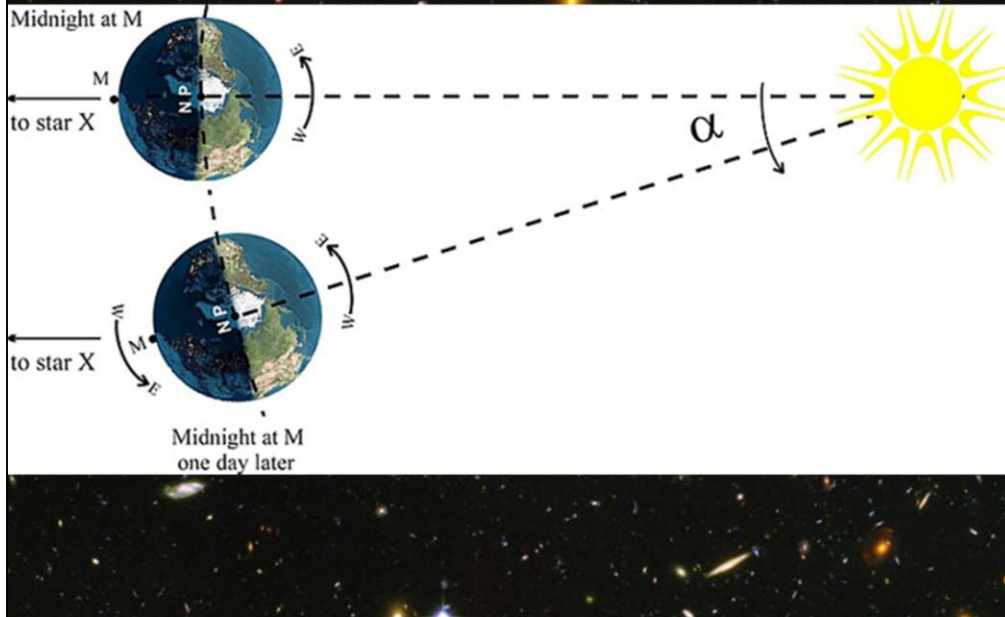
The motion of the stars over the course of a day is due to the Earth's rotation. Because we "feel" stationary, the stars appear to rotate around our north/south axis. Primarily this means stars rise in the east and set in the west, except where they are circumpolar (always above the horizon) and you can see the rotation about the north or south pole.

Image Credit & Copyright: Peter Michaud (Gemini Observatory), AURA, NSF (star trails above Mauna Kea)
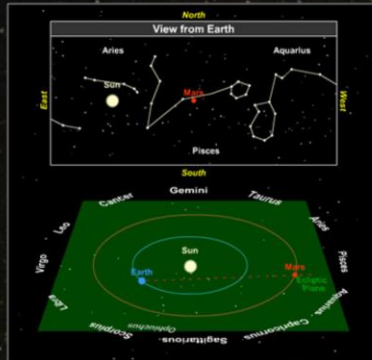
Motions in the Sky: months

The motion of the stars over the course of months shows that they moved slowly westward when observed at the same time of day. This is because the Earth orbits the sun in the same direction that it rotates, which makes the sun appear to go the other way (as you saw in the tutorial, the sun moves eastward through the constellations over time).

Remember what happened in Stellarium when you were watching the planets?

At last there's no PERMANENTLY dark side of the Moon.

The Moon has day and night just like the Earth.

The odd thing is that it always keeps the same face towards us.

So- there is a FAR side of the Moon.

The far side of the Moon hadn't been seen by human beings until the Apollo Missions.
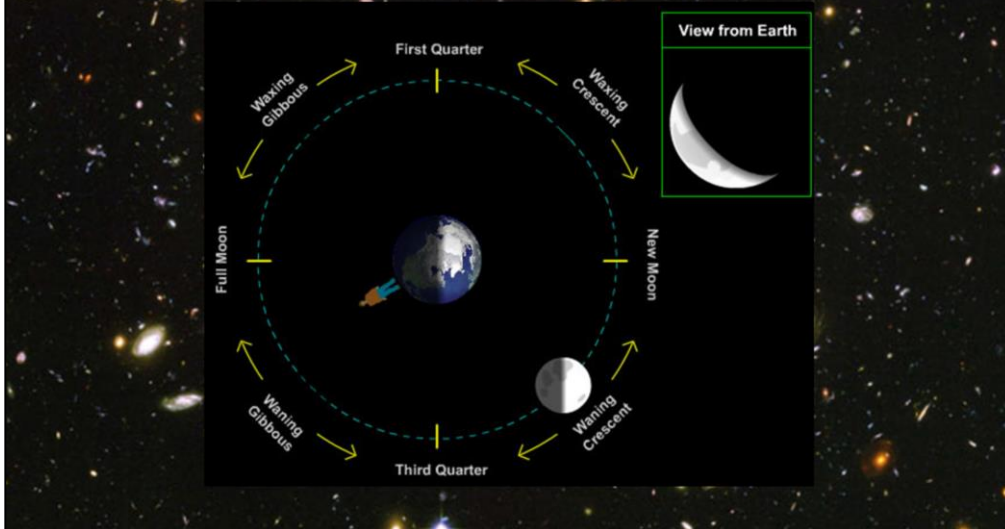
The animation shows one complete lunar day as seen from the Earth, called a "Lunation"

Notice that we ALWAYS see roughly the same side.

What's up with Moon Phases anyway?

Lecture tutorial: the cause of moon phases
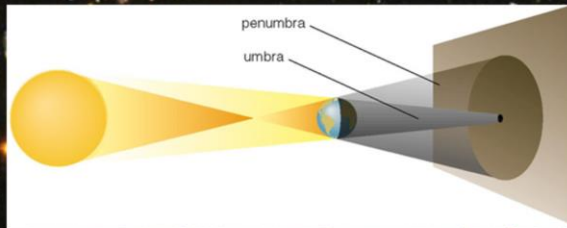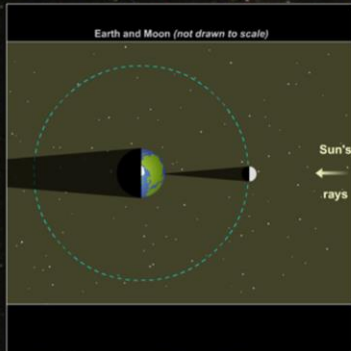
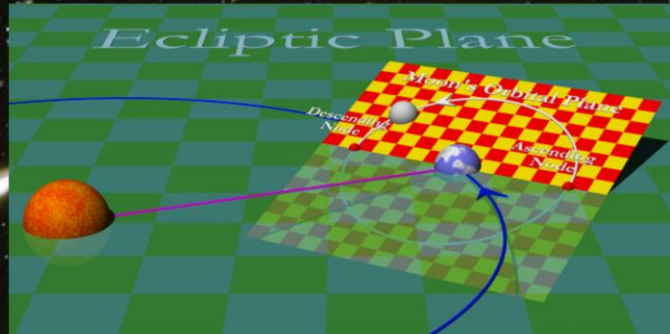You are in the penumbra when you can see part of the sun around the moon.

You are in the umbra when the entire sun is blocked.

There is a potential for an eclipse twice a year with a sun/node/earth alignment.

There is no guarantee that the moon will actually pass through the node at the right time.

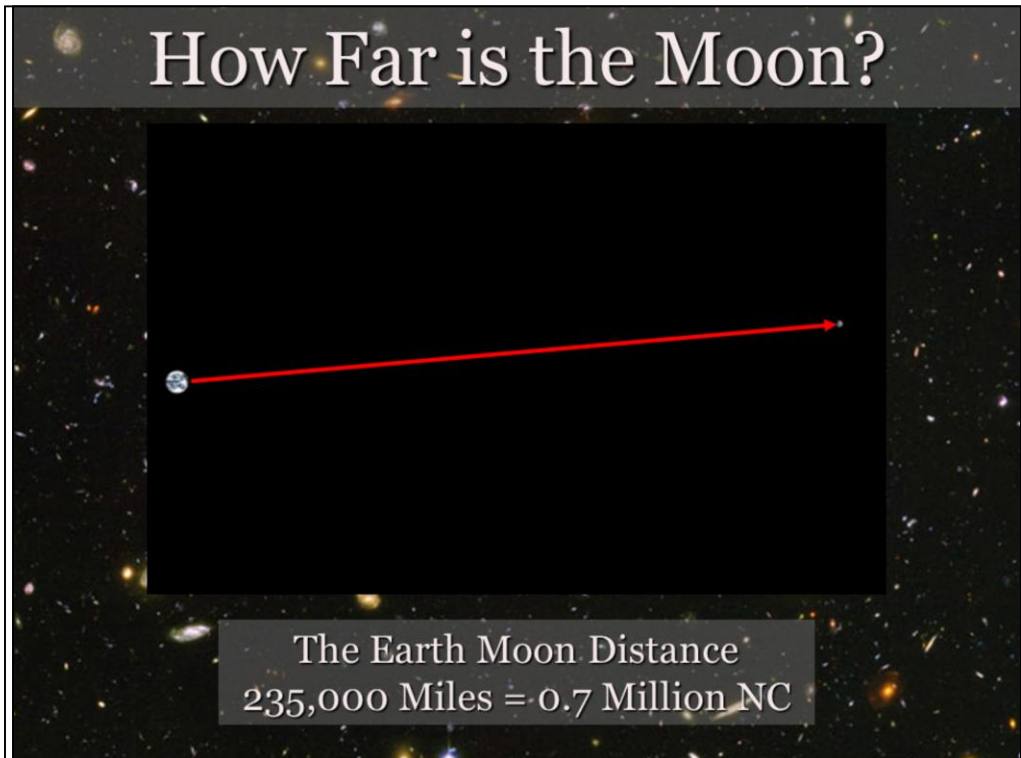Moon's radius: 1079mi (1,737.5km) if diam ~ 3.5cm ->

Earth radius: 3,959 miles (6,371 km) then diam ~ 12.7cm ->

Earth-Moon Distance: 238,900 miles (384,400 km) and then -> dist ~ 384cm = 3.84m

About 30 Earth diameters

How Far is the Moon?

The Earth Moon Distance
235,000 Miles = 0.7 Million NC

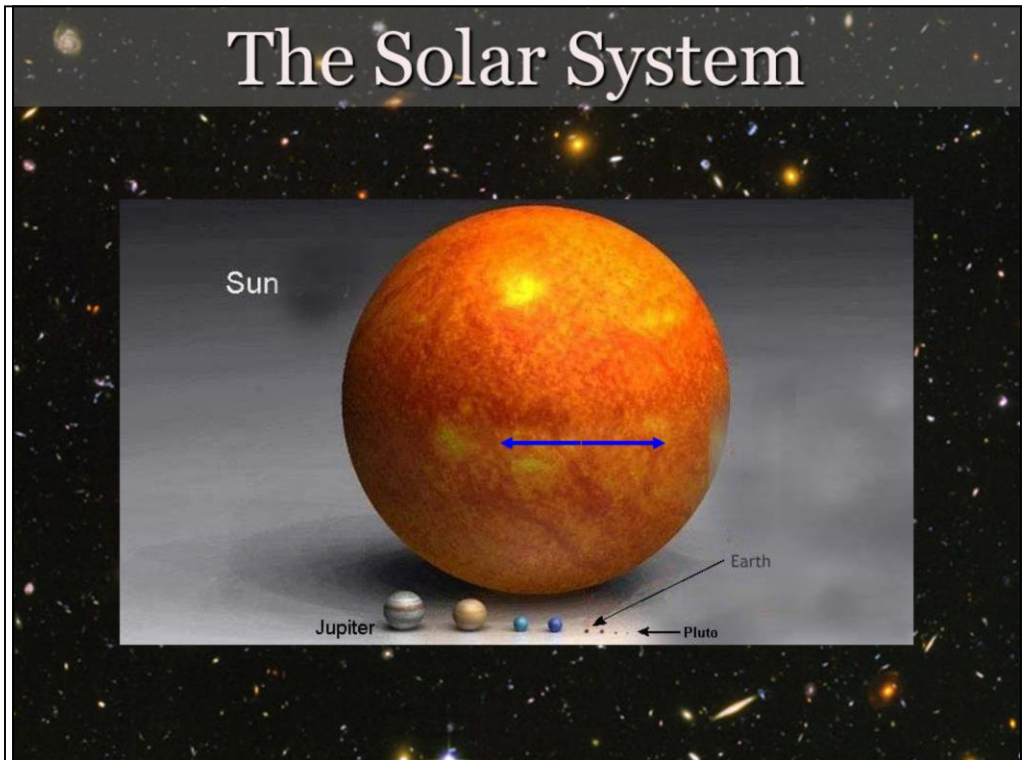You can see why they are rarely drawn to scale.

You could walk to the Moon in about 6.7 years at 13 NC/hour
You could imagine a particularly well built car driving 235,000 miles.

Moon's radius: 1079mi (1,737.5km) if diam ~ 3.5cm ->
Earth radius: 3,959 miles (6,371 km) then diam ~ 12.7cm ->
Earth-Moon Distance: 238,900 miles (384,400 km) and then -> dist ~ 384cm = 3.84m

The Sun completely dominates the solar system.

The Earth/Moon system fits easily inside the Sun. Twice
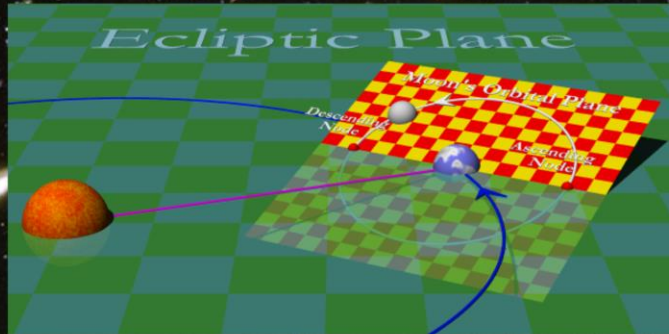The arrows represent the entire DIAMETER of the Moon's orbit around the Earth.

The Sun has 99.87 percent of the mass of the Solar System.

The Sun is a rather small star though…

Eclipses

Shouldn't there be one every month?

The Moon's orbital plane is tilted 5° with respect to the ecliptic

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Earth-Moon Distance: 238,900 miles (384,400 km) and then -> dist ~ 384cm = 3.84m

Demo

Moon's radius: 1079mi (1,737.5km) if diam ~ 3.5cm -> ping pong ball

Earth radius: 3,959 miles (6,371 km) then diam ~ 12.7cm -> big Styrofoam ball

Earth-Moon Distance: 238,900 miles (384,400 km) and then -> dist ~ 384cm = 3.84m

SUN: Need a light!

Summary

- **Science involves**
  - Hypothesis
  - Observations
  - Testing & Revision
  - Creativity!!!

- **Motions in the sky**
  - Seasons
  - Moon Phases & Eclipses
  - Retrograde Motion

- **Scale of the Universe**
  - Planets,
  - solar/stellar systems
  - galaxies
  - galaxy groups
  - observable universe
  - The Universe