Important Notes:

- Homework #1 is Due at the beginning of class next time.
- Attendance Sheet is going around one last time!
Homework Questions?
Help Session Schedule in Thorton 411

Mon 9 am - 2 pm
Mon 5 pm - 6 pm
Thu 10 am - 11 am
Fri 12 pm - 1pm
Fri 5 pm - 6pm
Recall:

- When we observe the night sky, we notice that the stars all move together in a particular way.
- The Moon, Sun, stars, all rise in the East, set in the West.
- The Celestial Sphere model allows us to predict the apparent motions of these objects extremely well. When and in what direction.
- While the stars are fixed to the Celestial Sphere, the Sun and Moon (and planets) all move along a line on the CS called the ecliptic.
Earth orbits the Sun in the Ecliptic Plane.

We see different constellations at different times of the year.
**Winter Hexagon** - for us, it’s highest in the sky at 9 pm during the Winter.
Summer Triangle - for us, up at night in the Summer!
How long does it take the Celestial Sphere to complete one rotation, from our perspective on Earth?

A. day  
B. month  
C. year  
D. it doesn’t rotate, the Earth does
The stars (not including the Sun) complete one trip around the Celestial Sphere in a . . .

A. day
B. month
C. year
D. never, the positions of the stars are fixed to the Celestial Sphere
The Sun completes one trip around the Celestial Sphere in a . . .

A. day
B. week
C. month
D. year
We haven’t talked about this yet, but try to guess about how long you think it takes the Moon to make one trip around the CS... 

A. day  
B. week  
C. month  
D. year
Multiplying and Dividing Powers of 10

- When multiplying, add the exponents:
  \[ 10^3 \times 10^4 = 10^{3+4} = 10^7 \]

- When dividing, subtract the exponents:
  \[ \frac{10^4}{10^3} = 10^{4-3} = 10^1 = 10 \]
Example: let’s evaluate the following with units!

1. \((2 \times 10^{-3} \text{ kg}) \times (5 \times 10^6 \text{ kg}) = ?\)

2. \(\frac{3 \times 10^8 \text{ m}}{3 \times 10^{-7} \text{ m/s}} = ?\)
Group Activity 1 - Groups of 2 or 3

Celestial Sphere
Rotation

Star B

Star A

Celestial Sphere

North Star

Earth’s Equator

Horizon

Celestial Sphere Rotation
WHY ARE THERE SEASONS?
IDEAS?
• Let’s imagine the Sun lighting up the Earth.
• Each square hole allows the same energy to reach the Earth.
• Since Earth is a curved surface, the energy is spread over a larger area as you get closer to the poles.
• The Earth is tilted $23.5^\circ$ with respect to the ecliptic plane.
• How does this affect how the Earth is lit up over the course of a year?
• Does the North Pole always point toward the Sun?
What do we notice about this image?

- Spring in the northern hemisphere; autumn in the southern hemisphere
- Winter in the northern hemisphere; summer in the southern hemisphere
- Summer in the northern hemisphere; winter in the southern hemisphere
- Autumn in the northern hemisphere; spring in the southern hemisphere
What do we notice about this image?

What parts on Earth receive the highest intensity of sunlight when?
Why we have Seasons

- The seasons are caused by the tilt of the Earth’s Axis.
- During Summer (Northern Hemisphere), the Sun’s rays are more direct...
- ...the days are also longer.
- During Winter (Northern Hemisphere), the Sun’s rays are less direct...
- ...the days are shorter.
- Seasons are not caused by the changing proximity to the Sun (Earth has a nearly circular orbit).
Which Season is Which?

Sunset 5:30 pm
Sunrise 8:15 am

Sunset 7:05 pm
Sunrise 6:55 am

Sunset 8:30 pm
Sunrise 5:25 am

Sunset 6:50 pm
Sunrise 6:45 am
Seasons: Northern Hemisphere

- **Vernal Equinox**, March 20, the days and nights are both 12 hours long.
- The Sun rises directly East and sets directly West.
- As the Earth orbits, the Sun starts rising North of East and setting North of West...
- ...the length of the Sun’s path in the sky gets longer, which makes the days longer...
- until...
Seasons: Northern Hemisphere

- **Summer Solstice**, June 21, is the longest day of the year.
- The Sun rises in the Northeast and sets in the Northwest.
- As the Earth orbits, the Sun starts rising North of East and setting North of West. . .
- . . . the days begin to get shorter again. . .
- until. . .
Seasons: Northern Hemisphere

- **Autumnal Equinox**, September 23, the days and nights are both 12 hours long again.
- The Sun rises directly East and sets directly West.
- As the Earth orbits, the Sun starts rising South of East and setting South of West. . .
- . . .the length of the Sun’s path in the sky continues to get shorter, which makes the days shorter. . .
- until. . .
Seasons: Northern Hemisphere

- **Winter Solstice**, December 22, the shortest day of the year.
- The Sun rises Southeast and sets Southwest.
- As the Earth orbits, the Sun starts rising South of East and setting South of West...
- ...the length of the Sun’s path in the sky gets longer again, which makes the days longer...
- until Vernal Equinox.
MOTION AND PHASES OF THE MOON
• Like the Sun, the Moon rises in the East and sets in the West.

• The Moon completes one revolution on the Celestial Sphere in about a month.

• The Sun illuminates half of the Earth and half of the Moon at a given time, no matter what phase we see (or don’t!).

• The phases of the Moon are generated from the Moon orbiting the Earth.
There are 4 Principle Phases

- When the Moon is fully lit, it’s called **Full**.
- When the Moon’s right half is lit, it’s called **First Quarter**.
- ...left half is lit, it’s called **Last Quarter**.
- When none of the Moon is visible, it’s called **New**.
• The period of Lunar phases (from Full Moon to Full Moon) is 29.5 days.
• The word ‘month’ comes from word ’moon’.
• Since the period is not perfectly in sync with the calendar months, it’s not guaranteed that particular phases occur on particular dates, i.e. New Moon doesn’t necessarily happen on the 1st of every month.
• If the Moon appears to be getting larger each night, it’s said to be **waxing**.
• . . . if it appears to be getting smaller each night, then it’s said to be **waning**.
• If less than half is visible then it’s called **crescent**.
• If more than half is visible, then it’s called **gibbous**.
Because the phase of the Moon depends on its position in the sky with respect to the Sun, a Full Moon always rises at Sunset.

A Crescent Moon is either setting just after Sunset, or rising just before Sunrise.
SOURCES

Astronomical images courtesy of http://apod.nasa.gov/
http://www.nature.com/
http://www.stellarium.org/
http://www.skyandtelescope.com