Friday Jan. 28

Syllabus and class notes are at: www.as.utexas.edu
go to courses, AST301 – Introduction to Astronomy – Lacy

Homework is due now in the back of the room.
Also pick up next week’s homework.

Read Chapter 4 for Monday.
Topics for this week

Know what the magnitudes of stars tell you about their relative brightnesses

Describe the apparent motions of stars across the sky during a night as seen from various locations on Earth

Describe and explain the apparent motion of the Sun relative to the stars during a year

Explain how the tilt of the Earth’s axis causes the seasons

Describe how the path of the Sun across the sky during a day differs during different seasons

Describe and explain the phases of the Moon and the motion of the Moon relative to the stars during a month

Explain how eclipses occur
Apparent motion of Sun during the year

The Earth orbits the Sun once a year. This makes the Sun appear to pass in front of different stars (the constellations of the zodiac) during a year.

The zodiac does not lie on the celestial equator, but is on a circle tipped about 23° from the equator. This is because the axis of the Earth’s rotation is tipped about 23° from the axis of its orbital motion.

During a day the Sun follows the same path across the sky as the stars it is in front of, since this motion is caused by the rotation of the Earth.

But from day to day the Sun slowly moves along the zodiac (also called the ecliptic).

This causes it to rise with different stars and to move north and south of the celestial equator during a year.
The solar day and the sidereal day

The motion of the Sun along the ecliptic causes the time from sunrise to sunrise (the solar day = 24 hours) to differ from the time from when one star rises until when it next rises (the sidereal day = 23 hours, 56 minutes).

There are 365.24 solar days in a year.
How many sidereal days are there in a year?
Seasons

The fact that the ecliptic is tipped relative to the celestial equator means that at some times of the year the Sun is in front of stars north of the celestial equator and at some times it is south.

Stars on the equator rise due east, pass 30° south of overhead (seen from Austin), and set due west.

Stars north of the equator rise north of east, pass closer to overhead, and set north of west.

Stars south of the equator rise south of east, pass more than 30° south of overhead, and set south of west.

What path is the Sun currently following across the sky?
If you don’t know, watch it.
At winter solstice
The earth’s axis of rotation always points toward the same place in the stars (the celestial pole), even as the earth goes around the sun. The polar axis is tilted by 23.5 degrees with respect to the ecliptic plane.
Summer solstice light

Winter solstice light
The Moon: Phases, Eclipses, etc.

Most questions about the appearance of the Moon can be answered by drawing the right drawing:

The Moon orbits around the Earth in the same direction as the Earth rotates. The Sun lights up the side of the Moon (and Earth) that faces the Sun.

Eclipses (but not phases!) are caused by shadows of the Earth and Moon on each other.

Typical questions:

What time does the Moon rise and set in each of its phases?

What phase is the Moon in just before a solar eclipse?

What phase is the Moon in just before a lunar eclipse?
On Tuesday the Moon was full.
At what time of day was it overhead?
Draw yourself standing on the Earth with the full Moon overhead, and ask what time of day it is.
At what time of day did it rise?
Draw yourself on the Earth where you first see the Moon, and ask what time of day it is.
Quiz

Next Tuesday the Moon will be in the 3rd quarter phase.
At what time will it rise?
Hint: Draw the picture, remembering that everything moves counter-clockwise.
A. around sunrise
B. around noon
C. around sunset
D. around midnight
Quiz

Next Tuesday the Moon will be in the 3rd quarter phase. At what time will it rise?
A. around sunrise
B. around noon
C. around sunset
D. around midnight

Draw the picture.
Quiz

The Moon will be in 3rd quarter phase next Tuesday. What phase will the Moon be in a week from next Tuesday?
A. new
B. full
C. 1st quarter
D. 3rd quarter
Quiz

What phase will the Moon be in a week from next Tuesday?
A. new
B. full
C. 1\textsuperscript{st} quarter
D. 3\textsuperscript{rd} quarter

The Moon takes about 4 weeks to orbit the Earth, so it goes from 3\textsuperscript{rd} quarter phase to new phase in a week.

When will it rise?
Lunar eclipse
Eclipses

Lunar eclipses (when the Moon disappears, or at least gets darker) occur when the shadow of the Earth falls on the Moon.

Solar eclipses (when the Sun is hidden) occur when the Moon passes in front of the Sun, blocking our view. In that case, the shadow of the Moon falls on us.

What is the phase of the Moon just before a lunar eclipse?
A. new
B. full
C. 1st quarter
D. 3rd quarter
Eclipses

Lunar eclipses (when the Moon disappears, or at least gets darker) occur when the shadow of the Earth falls on the Moon.

Solar eclipses (when the Sun is hidden) occur when the Moon passes in front of the Sun, blocking our view. In that case, the shadow of the Moon falls on us.

What is the phase of the Moon just before a lunar eclipse?
A. new
B. full Draw the picture!
C. 1st quarter
D. 3rd quarter
Eclipses and the ecliptic

Why isn’t there a lunar eclipse every full Moon?

The reason is that the orbit of the Moon isn’t exactly in the same plane as the orbit of the Earth (the ecliptic). Usually the Moon passes above or below the Earth’s shadow.

There are only 1 or 2 lunar eclipses each year.
And we only see an eclipse if we are on the side of the Earth facing the Moon (i.e. the Moon is up).
Solar eclipse
Eclipses and the ecliptic

Why isn’t there a solar eclipse every new Moon?

It’s almost the same reason. Usually the Moon’s shadow passes above or below the Earth. Also, the Moon’s shadow is very small when it hits the Earth, and only those people in the shadow see a solar eclipse.