Second on-line Reading Quiz due tonight! The second on-line reading quiz ("Week3 quiz") is due tonight, Tuesday, September 23, by 11:55 PM. After that time, this reading quiz will no longer be available, and no late assignments will be accepted for any reason.

Reading Quiz solutions available online. Complete solutions to all reading quizzes are posted to the textbook website ten minutes after the quiz is due, and are called, e.g., “Week2 quiz solutions”. Note that these are complete, worked-out solutions with explanations, not just answers. You can access these solutions by logging onto the textbook website, clicking on the “Assignment/Tests” tab, and then clicking on either the “Print blank assignment” link or the “Take” button. Clicking on the “Print blank assignment” link produces a pdf file of the solutions that can be printed out. Clicking on the “Take” button allows you to “take” the quiz again, but this time with the solutions included. Note that if you “take” the quiz again, your score does not count; re-taking the quiz is just for your own practice.

The quiz solutions are also available at the course website (http://sciences.sdsu.edu/~leonard/astro101) by the end of each week that a quiz is due, and are accessed by clicking on the “On-Line Reading Quiz Solutions” link on the course homepage.

Reading Guide and Homework Assignment
(Week #4 On-Line Reading Quiz Due: Tuesday, September 30, 11:55 PM)

This week, we finish up Chapter 2 of your text, and add mathematical meat to the qualitative bones that were assembled last week in the lectures. We also begin our study of the Solar System, with the study of eclipses.

1. Text – Chapter 2, §2.2.3 and 2.2.4: Mass, Volume, and Density, and Angular Momentum.
   Read here about these important basic concepts that were presented in class.

2. Text – Chapter 2, Section §2.3: Universal Gravity.
   This describes Newton’s discovery and quantification of the force of gravity. Newton’s universal law of gravity is one of the most important equations we shall encounter in the course (and one of the few formulas that you are expected to know). It tells you the force, \( F \), of gravitational attraction that exists between two objects with masses \( M_1 \) and \( M_2 \) that are separated by a distance \( R \):

   \[
   F = \frac{GM_1M_2}{R^2}.
   \]

   Note that \( R \) is the distance between the two objects’ centers, NOT their surfaces. \( G \) is the so-called “gravitational constant,” whose exact value you do not need to know — any problems that you are given concerning this law will involve solving a ratio, and so the actual value of \( G \) will not be needed.
   A key thing to understand about this law is that it is an example of an inverse square relation: that is, the gravitational force decreases as the inverse square of the distance between the objects. For instance, if you *double* the distance between two objects, the force of attraction that they feel towards each other becomes only \(
\frac{1}{4}
\) as strong as it was before. We shall see that inverse square relations play very important roles in astronomy and physics. Note also Newton’s version of Kepler’s 3rd law on p. 51 of the text. This law is of key value since it allows astronomers to derive the mass of an astronomical object that has another body in orbit around it.

   This reading finishes off the chapter with a discussion of orbits, asteroids, spacecraft and, finally, the discovery of Neptune – a triumph for Newtonian physics! A key term defined along the way is escape velocity: the speed needed to completely escape the gravitational pull of an object (e.g., the Earth).
4. **Course Reader: Pages 171 – 176: Kepler and Newton.**

This is the first of several reading excerpts from an excellent astronomy text, *Your Cosmic Context*, by Todd Duncan and Craig Tyler. Here, you are given a well-written and thoughtful summary of Kepler’s Laws of Planetary Motion, and Newton’s Universal Law of Gravity. The pedagogical style and order in which the concepts are presented actually follows the lectures more closely than does your textbook reading. With these three presentations at your disposal (i.e., lectures, text, Reader), it is hoped that you have gained a complete understanding of this material, one which will serve you well for the remainder of the course!

5. **On-line tutorial:** On the “Week4 tutorial” section of the textbook website, start by looking at the *Active Figure* called “Gravity and Orbits”. This allows you to recreate Isaac Newton’s thought experiment involving firing a cannonball at different velocities. You need only look at the first page of this exercise (pages 2, 3, and 4 present more advanced material for which you are not responsible). Try several different velocities and see what happens. For instance, set the “Initial Velocity” to be 7.8 km/sec, and click “Fire!”. Then, up the velocity to 7.9 km/sec and fire away. What difference do you see? 7.9 km/sec is, evidently, very close to the velocity of an object in circular orbit about the Earth close to its surface. Also try the special velocity, called the *escape velocity*, of 11.2 km/sec. Next, look at the *Astronomy Exercise* called “Escape Velocity”. This applet is essentially a more detailed version of the *Active Figure* you already looked at already. Finally, look at the *Astronomy Exercise* entitled “Orbital Motion”. This allows you to see the effects that changing the Sun’s mass, distance between a planet and the Sun, and/or the planet’s orbital eccentricity has on the planet’s orbit. For instance, set the Sun’s mass to be 0.5 (i.e., half its actual value), and click Start. Then, set it to be 2.0 and click Start. See how much faster the planet orbits when the Sun has more mass!

→ **Optional Astronomy Podcast, from Astronomycast.com:** Episode 102: *Gravity*, available at [http://www.astronomycast.com/](http://www.astronomycast.com/), as well as through iTunes. (Note that, unfortunately, a transcript of this show is not yet available, so you’ll have to listen to it!) This week’s suggested podcast concerns the mysterious force called *gravity*, and presents a nice overview of Newton’s discovery and description of it. The Podcast also goes well beyond what we covered this week in class, discussing Albert Einstein’s 20th-century revision of gravity theory in a grand vision of space and time that he called General Relativity. We shall discuss General Relativity in the course in Weeks 11 and 12, so by listening to this Podcast, you’ll be ahead! Again, listening to these podcasts is completely OPTIONAL.

6. **Course Reader: Pages 168 – 170: Angular Size.**

This reading presents the very important concept of *angular size*, which is essential to your understanding of the next reading from your textbook, on eclipses.

7. **Text – Chapter 3, Section §3.7: Eclipses of the Sun and Moon.**

We are covering just the final section from Chapter 3 in this class, on solar and lunar eclipses. The key points to take away from this reading are (1) the relative positions of the sun, moon, and Earth for both kinds of eclipses; and (2) the characteristics of both kinds of eclipse (i.e., eclipse duration, region on Earth’s surface from which each is visible, and eclipse frequency).

8. **On-line reading quiz (Due: 11:55 PM, Tuesday, September 30):** Take this week’s *reading quiz* by clicking on the “Week4_quiz” assignment at the on-line textbook web-site. The Reading Quiz will become available to you at 12:05 AM, Wednesday, September 24. It consists of 10 multiple choice questions. **You must complete this on-line quiz by 11:55 PM Tuesday, September 30.** As always, you may take the quiz twice.