ASTR 101: PRINCIPLES OF ASTRONOMY
SPRING 2015
SCHEDULE #20276

COURSE INFORMATION

Class Days: Tuesday and Thursday
Class Times: 9:30 AM – 10:45 AM
Class Location: PG-153

Professor: Douglas C. Leonard
Contact Information:
Office Hours Days: Friday
Office Hours Times: 10:00 AM – 12:00 PM
Office Hours Location: Physics 238
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Course Overview

Official Course Catalog Description: Discover the universe: planets, stars, galaxies, and our place in the cosmos; the Big Bang; how stars shine; comets, meteors, nebulae, the Milky Way; black holes and other exotic objects. Not open to students with credit in Astronomy 201.

Purpose and Course Content: Finding our place in the universe has been a perennial human pastime. Here we present the results of this ongoing endeavor, covering such topics as the solar system, stars, black holes, galaxies, and cosmology. A particular emphasis will be placed on the historical development of ideas and their philosophical implications. The class assumes no prior background in astronomy, although a general knowledge of science at the high-school level will be helpful. Mathematics will be limited to algebra and geometry.

Student Learning Outcomes: Upon completing this course, you should be able to:

- Describe the physical location of the Earth with respect to the other constituents of the observable universe, and articulate the process by which humans attained this understanding;
- Convince a fellow student who has never taken an astronomy class that it is possible to determine the chemical constituents of a star without ever visiting it, through the careful analysis of its light;
- Explain the process by which stars, like our sun, produce energy during their lives, and how and why they ultimately die;
- Present the currently favored scientific theory for what the ultimate fate of our universe will be, and outline the astronomical observations upon which the theory is based;
- Describe at least three major areas in which our astronomical knowledge is known to be incomplete;
- Read and comprehend articles concerning astronomy that appear in the popular press, and participate in discussions about them.

Relation to Other Courses: This course is one of nine courses that you will take in General Education **Foundations**. Foundations courses cultivate skills in reading, writing, research, communication, computation, information literacy, and use of technology. They furthermore introduce you to basic concepts, theories and approaches in a variety of disciplines in order to provide the intellectual breadth necessary to help you integrate the more specialized knowledge gathered in your major area of study into a broader world picture.

This course is one of four **Foundations** courses that you will take in the area of **Natural Sciences and Quantitative Reasoning**. Upon completing **Natural Science** Foundations courses in physical sciences, life sciences, and a lab, you will be able to: 1) explain basic concepts and theories of the natural sciences; 2) use logic and scientific methods to analyze the natural world and solve problems; 3) argue from multiple perspectives about issues in natural science that have personal and global relevance; 4) use technology in laboratory and field situations to connect concepts and theories with real-world phenomena. Upon completing a Foundations course in **Quantitative Reasoning** you will be able to: 1) apply appropriate computational skills and use basic mathematical concepts to analyze problems in natural and social sciences; and 2) use methods of quantitative reasoning to solve and communicate answers to real-world problems.

Enrollment Information

Prerequisites: The only prerequisite is student interest; there are no *college-level* prerequisites.

The use of mathematics will be kept to a minimum, and in most cases is not needed for a basic understanding of the *concepts*. However, in some cases a *quantitative* understanding is as important as a *qualitative* understanding. A *Mathematical Toolkit* is provided in the first week of the course that reviews all essential mathematical skills needed for the course.

Adding/Dropping Procedures: To be added to the "wait-list" for the course, you must attend the first class (Jan. 22) and then follow all instructions on the handout, "How to Crash This Class" (also available at: (http://sciences.sdsu.edu/∼leonard/astro101) . "Crashers" will be accomodated on a space-available basis.

Statement for Students with Disabilities: If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Disability Services. Your cooperation is appreciated.

Course Materials

Required Course Material:

Text: *Voyages To the Stars and Galaxies*, third edition by Andrew Fraknoi, David Morrison, & Sidney C. Wolff.

Course Reader: Contains Powerpoint slides, weekly assignments, exam information, and additional required reading material.

Options for Accessing Course Materials: *Text* may be purchased (used copies and rentals are fine) at the campus bookstore or elsewhere. *Reader* is only available for purchase at the campus bookstore, and must be purchased new (past semesters' copies will not work). Note that there are *two* copies of the course Textbook and *one* copy of the course Reader available at the Circulation / Course Reserves Desk in Love Library; they may be checked out for 2 hours, and all course handouts and Powerpoint slides shown in lecture are posted to the course's Blackboard website (http://blackboard.sdsu.edu).

Course Structure and Conduct

Style of the Course: This course will be a traditional lecture course, with active student participation and questions encouraged.

Course Schedule[1]

Week 1 (January 22 → January 28): *A Beginning*

Topics covered – The supernova of 1054 A.D.; the finite speed of light and the cosmic time machine; a brief tour of the universe; introduction to the night sky and the celestial sphere; conceptual schemes; the nature of science.

Week 2 (January 29 → February 4): *Finding our Place in the Universe*

Topics covered – Constellations; basic astronomical observations every theory must explain: motion of stars, Sun and planets; the zodiac; retrograde motion; astronomy in ancient times; size and shape of the Earth: A mathematical toolkit; Eratosthenes measures the Earth; the construction of cosmologies; Ptolemy's *Almagest*: the geocentric cosmology that (nearly) everyone believed; Aristarchus' heliocentric proposal; Aristotle and Plato.

→ Last day to add or drop classes: Tuesday, February 3.

Week 3 (February 5 → February 11): *A Monk Moves the Earth*

Topics covered – Copernicus' *De Revolutionibus*; Galileo's telescope, and the "proof" that the geocentric cosmology is wrong; the nature of science; Ptolemy's *Tetrabiblos* and the perceived power of astrological prediction; Hipparchus and precession; alileo's impact on astronomy, physics, and science; Tycho's observations and painful death; Kepler's Laws; Isaac Newton's genius: the *Principia* and his first two Laws of Motion.

• Online Reading Quiz #1 due Thursday, February 5, 11:55 PM.

Week 4 (February 12 → February 18): *Gravity Explains it All*

Topics covered – Newton's third law; gravity; orbital motions; testing a prediction: the discovery of Neptune; Newton's version of Kepler's Third Law; solar and lunar eclipses; origin and age of the solar system.

• Online Reading Quiz #2 due Thursday, February 12, 11:55 PM.

→ Optional planetarium show Friday, February 13, 10:00 AM.

Week 5 (February 19 → February 25): *Other Worlds*

Topics covered – A tour of the solar system: planets, moons, asteroids, and comets; meteors; introduction to matter and light; structure of atoms; periodic table of elements.

• Online Reading Quiz #3 due Thursday, February 19, 11:55 PM.

• Online Reading Quiz #4 due Tuesday, February 24, 11:55 PM.

[1] All dates subject to changes announced in class. Each "Week" consists of two class days and so, depending on holidays, may "begin" on either a Tuesday or on a Thursday. Please consult each week's *Weekly Handout* for the specific textbook and Course Reader readings assigned each week. Preliminary versions of the Weekly Handouts are contained in the Course Reader, with the final versions posted to the course web-site by 2:00 PM the day before each week starts.

Week 6 (February 26 → March 4): *Light: It's All We Have, Part I*

Topics covered – Basic properties of light: speed, dispersion, ROYGBIV; the science of spectroscopy; apparent brightness, luminosity, inverse square law of light propagation and the utility of standard candles; refraction; dispersion; intoduction to the science of spectroscopy: the continuous spectrum and the fingerprints of the elements.

→ **Midterm Exam #1 taken in class on Thursday, February 26.**

Week 7 (March 5 → March 11): *Light: It's All We Have, Part II*

Topics covered – Kirchoff's Laws; light as a wave: the electromagnetic spectrum, radial velocity, Doppler effect, blue(red) shift; the discovery of extrasolar planets; proper motion.

Week 8 (March 12 → March 18): *Powering the Stars: Einstein Shows the Way*

Topics covered – Measuring celestial distances with parallax; light as a particle: photons, and a brief introduction to quantum mechanics; introduction to continuous radiation: hotter means bluer and brighter; sunspots; Cecelia Payne-Gaposchkin's thesis, and the discovery of the sun's composition; energy source of the Sun and stars: Nuclear fusion; $E = mc^2$: $1 + 1 < 2$; neutrinos and antimatter.

• Online Reading Quiz #5 due Thursday, March 12, 11:55 PM.

Week 9 (March 19 → March 25): *How Stars Live*

Topics covered – Hydrostatic equilibrium; stellar evolution: How stars are born and how they live; low-mass vs. high-mass stars; approaching stellar death.

• Online Reading Quiz #6 due Thursday, March 19, 11:55 PM.

Week 10 (March 26 → April 8): *How Stars Die*

Topics covered – Binary stars; stellar corpses I: The death of low-mass stars, white dwarfs, Chandrasekhar limit; stellar corpses II: The death of high-mass stars, neutron stars, black holes, core-collapse supernovae; synthesis of heavy elements; SN 1987A; pulsars; binary star evolution: Novae and Type Ia supernovae.

• Online Reading Quiz #7 due Thursday, March 26, 11:55 PM.

→ Note: No class on Tuesday, March 31 or Thursday, April 2 (Spring Break).

Week 11 (April 9 → April 15): *Hearts of Darkness I: An Introduction to Black Holes*

Topics covered – Wrap-up of stellar evolution; introduction to black holes: singularity; event horizon; finding black holes and proving that they exist.

• Online Reading Quiz #8 due Thursday, April 9, 11:55 PM.

→ **Midterm Exam #2 taken in class on Tuesday, April 14.**

Week 12 (April 16 → April 22): *Hearts of Darkness II: Into the Belly of the Beast*

Topics covered – Einstein's General Theory of Relativity I: The principle of equivalence, and the deflection of starlight; curved space; Einstein's General Theory of Relativity II: Distorted time and gravitational redshift; adventures near a black hole; entering the Realm of the Nebulae.

Week 13 (April 23 → April 29): *The Realm of the Nebulae*

Topics covered – Edwin Hubble, the great Nebula Debate, and the birth of extragalactic astronomy; standard candles ('bulbs') revisited: Cepheid stars; a universe of galaxies; the mystery of dark matter; supermassive black holes.

• Online Reading Quiz #9 due Thursday, April 23, 11:55 PM.

Week 14 (April 30 → May 6): *The Expanding (and Accelerating) Universe*

Topics covered – Edwin Hubble discovers a law: The expanding universe; Big Bang cosmology; age of the universe; cosmological redshift; the effects of gravity and the expected deceleration; determining the expansion history of the universe with supernovae; the surprise of the century: the accelerating universe; the fate of our universe.

• Online Reading Quiz #10 due Thursday, April 30, 11:55 PM.

• Online Reading Quiz #11 due Tuesday, May 5, 11:55 PM.

Week 15 (May 7 → May 13): *An Ending and a Beginning*

Topics covered – Wrap-up and review for final exam; Sisyphean nightmares and happiness.

• Online Reading Quiz #12 due Thursday, May 7, 11:55 PM.

→ Note: The last class is Thursday, May 7.

→ **Final Exam:**

Section 1 (9:30 AM class): Thursday, May 14, 8:00 AM → 10:00 AM, Room PG-153 (normal lecture room).

Individual and Group Activities Required: There will be weekly reading assignments, along with (nearly) weekly on-line Reading Quizzes (multiple choice). The reading quizzes will be taken at the course text-book's web-site (http://www.ilrn.com), and will be automatically graded on-line immediately after you take the quiz, with scores recorded in percentile form. *Your lowest two homework assignment grades will be dropped when computing your final homework grade for the course.* Details on these assignments, and how to access and complete them on-line, will be given near the start of the course.

Technology Utilized in the Course: All class Handouts and Powerpoint slides shown in lecture will be posted to the Blackboard website shortly (i.e., usually within a day) after each lecture. Online homework will be completed at the text-book's web-site (http://www.ilrn.com). Note that neither a computer nor a calculator is needed for this course; online homework can be completed using the freely available computers at Love Library.

Course Assessment and Grading

Assignments and Course Grades

Course grades are based on the following scale:

Grade	Percentage
A	92.50 – 100%
A-	89.50 – 92.49%
B+	87.00 – 89.49%
B	82.50 – 86.99%
B-	79.50 – 82.49%
C+	77.00 – 79.49%
C	72.50 – 76.99%
C-	69.50 – 72.49%
D+	67.00 – 69.49%
D	62.50 – 66.99%
D-	59.50 – 62.49%
F	< 59.49%

Students taking the course using the credit/no credit option ("Cr/NC") will receive a grade of "Credit" for achieving an equivalent letter grade of C or better. "No credit" will be given for equivalent letter grades of C- and below.

The final course grade will be determined based on your work in the following areas:

- *Homework assignments*: 10% of the course grade. In addition to the weekly reading assignment, nearly every week there will be a set of multiple-choice "quiz" questions assigned for you to complete on-line, at the course text-book's web-site (http://www.ilrn.com). These assignments will be automatically graded on-line immediately after you take the quiz, with scores recorded in percentile form. *Your lowest <u>two</u> homework assignment grades will be dropped when computing your final homework grade for the course.* Details on these assignments, and how to access and complete them on-line, will be given near the start of the course.
- *Midterm Examination #1*: 20% of the course grade. The first midterm exam will be given in class on **Thursday, February 26**, and is worth 20% of the course grade. The nature of the midterm exams is described in the "Exam Preparation Material" section of the Course Reader, and will be discussed in detail a few weeks into the course.
- *Midterm Examination #2*: 30% of the course grade. The second midterm exam will be given in class on **Tuesday, April 14**, and is worth 30% of the course grade. It will be similar in form to the first midterm exam.
- *Final Examination*: 40% of the course grade. The final examination is a comprehensive exam covering the entire semester's material. It will be given at the following time and location:

  Section 1 (9:30 AM class): <u>Thursday</u>, May 14, 8:00 AM → 10:00 AM, Room PG-153 (normal lecture room).

  → **Note**: The University's final examination schedule is always posted online well before the start of each semester. San Diego State University policy expressly forbids the administration of final exams other than at the scheduled time (see p. 470 of the current General Catalog). Thus, **if you are not able to take the final exam at the scheduled time, then you can not take this section of**

Astronomy 101. Also, please note that it is your responsibility to create a schedule for yourself that does not result in having many finals on the same day; no special accommodation will be made for students who create a schedule for themselves that results in them having multiple final exams on the same day.

Excused Absence Make-up Policies: "Makeup exams" for the two midterms will be considered only for the most dire and verifiable circumstances beyond the control of the student.[2]

Grade Calculator Worksheet

To compute your final grade in the course:

Step 1: Write down all of your homework grades (percentage equivalents):

Step 2: Now, cross out the *lowest* two homework grades. Add the remaining grades together and divide by the total number of graded homework assignments (i.e., total number of homework assignments given minus 2). Write down that number here:

Step 3: Take the number obtained in step 2, and multiply it by 0.1. Write that number down here, and put a box around it:

Step 4: Take your first midterm exam percentage and multiply it by 0.2. Write down that number here, and put a box around it:

Step 5: Take your second midterm exam percentage and multiply it by 0.3. Write down that number here, and put a box around it:

Step 6: Multiply your final exam percentage by 0.4, and write that number here, and put a box around it:

Step 7: Add the boxed numbers from Steps 3, 4, 5, and 6 together and write it here. This is your final percentage grade for the course.

Step 8: Use the grade scale given on the previous page to calculate your final letter grade, and write it down here:

In all likelihood, this is your final grade for the course. In *exceptional* cases, if your grade falls near a borderline (i.e., within about 1% or so of the next grade) I may *raise* your grade by up to one mark (e.g., C- to C; B+ to A-, etc.) based on such subjective criteria as my sense of your overall *enthusiasm* for the class and course material. This can be demonstrated in many ways, including "class participation" (note that giving the sense that you are an engaged listener is considered to be just as important as actively contributing to the discussion), attendance, coming to office hours, evidence of effort and dedication, and so forth. Note that I will never *lower* a grade that you have earned; your enthusiasm can only help you.

→ A note on grading philosophy: With the possible exception of the small, subjective "grade boost" mentioned above, grades in Astronomy 101 are completely objectively determined based on student performance in the class. Grades in Astronomy 101 are thus earned by the student, based on performance on the exams and homework in the class; they are not "given" by the professor.

[2]To request an exam at a nonstandard time, please read and carefully follow all instructions on the form "Requesting an Exam at a Nonstandard Time", available at the Blackboard web-site (click on "Class Handouts", and then click on "Requesting an Exam at a Nonstandard Time"). Note that makeup exams will differ from the exams given in class, and may include (or consist entirely of) a one-on-one oral interview with the professor.

Other Course Policies

- **Late Homework**. No late homework assignments will be accepted for any reason; should you miss a homework assignment, then that will simply be one of the two homework grades that is dropped when computing your average for the "homework" component of the course.
- **Extra Credit**. There is no "extra credit" available in this course.
- **Cheating**. Consistent with University policy, cheating is not tolerated in Astronomy 101. If cheating is deemed to have occurred, a "0" will be recorded for the assignment or exam grade and an "Academic Dishonesty Incident Report" will be submitted to the Center for Student Rights and Responsibilities, where the incident will then be investigated by the Student Conduct Administrator who shall determine whether it is appropriate to charge a student with violation of the Student Conduct Code. Details on the judicial process (and the potential results, including "severance from the University") can be found at the Center for Student Rights and Responsibilities web page: http://csrr.sdsu.edu/index.html .
- **Incompletes**. **No course grades of "Incomplete" (I) will be given.**[3] If your performance in Astronomy 101 is less than satisfactory to you as the semester draws to a close, then your only options are:

  1. *Course Forgiveness*. At SDSU, you are permitted to retake up to 16 units of lower division courses when a grade of C- or lower is achieved, and have only the most recent grade counted towards your GPA. You can thus choose Course Forgiveness for Astronomy 101 if you do poorly the first time through, and retake it (once) in a future semester (either with me, or with a different professor) and hopefully improve your final grade. Please see p. 470 of the current SDSU General Catalog for all of the details on repeating a course.
  2. *Course Withdraw*. If you feel that you have a compelling case, you can petition to get a "late" (i.e., it's after the 10-class day drop period) withdraw from Astronomy 101. Please see p. 469 of the current SDSU General Catalog for details on the process. Note that all of the paperwork (this includes obtaining my signature, getting the approval of the dean of the college of your major, and filing the forms with the Registrar) must be completed by the last day of classes (Thursday, May 7, 2015). In general, I am sympathetic to allowing you to withdraw from the class if you have a solid, documented reason (i.e., I will give you my signature; convincing your dean and the Registrar is up to you!). Note, though, that the last time that I am available to sign a course withdraw form is Friday, May 1, 2015 at 12:00 PM (i.e., the end of my last office hour before classes end).
  3. *Complete withdraw from the entire semester.* If your performance in all (or most) of your classes has been severely impacted by a cause beyond your control, you can consider a complete "retroactive withdraw" from the University for the semester. Details on this process are on p. 476 of the current SDSU General Catalog. Note that this is your only option if it is after Wednesday, December 10!

  → Note that the best way to avoid having to chose among any of the above actions is to do well in the class! In this regard, I point out that the final exam is worth 40% of the course grade, so that a strong performance on that can drastically improve your final mark.
- **Contacting the professor.** Ordered from the *best* way to get in touch with me to absolute *worst* way to get in touch with me:

  1. **Best way:** *Come to office hours*. This is absolutely the best way to get help from me in a one-on-one (or small group) setting. My office hours are a low-pressure environment, and you don't even need to come with specific questions in mind – if you just want to talk about the material

[3] Except under only the most extraordinary circumstance — e.g., a severe and documented medical emergency that affects *only* a student's ability to take the Final Exam at semester's end (*all* other coursework must have been completed). See p. 469 of the SDSU General Catalog for official University policy on Incomplete grades.

in general or have me review some concepts with you that is fine. Office hours are Fridays, from 10:00 AM — 12:00 PM, in the physics building, Rm. 238 (P238), and I strongly encourage you to use them; no appointment is needed.

2. **Good way:** *Send me email.* This is an effective way to contact me directly. I am very responsive to emails, often responding within minutes and almost always within 24 hours. When sending me email please, if at all possible, send it to me in "plain text" format. It is difficult for my ancient emailer to read "rich-text" or "HTML-formatted" emails. Usually, you can change the format of your outgoing email by changing the "settings".
3. **OK way:** *Catch me right after class.* If you have a very quick question (or need to let me know something) that can be dealt with in under a minute or so, catching me right after class can be effective. Since another class begins immediately after ours, please *wait for me outside the lecture hall*, and I will speak with you there!
4. **Poor way:** *Call my office.* This is not such a great way to get hold of me, as I am frequently out of the office, or, if I am meeting with other students at the time, I may not even answer the phone. Send email, and you'll likely get a better response.
5. **TERRIBLE way:** *Come up right before class.* Please do not try to talk with me immediately before class, either at my office or in the lecture room. This is absolutely the worst time to attempt to communicate with me. Before lecture I am likely busy getting the lecture material ready/Powerpoint working/etc. If it's a quick question, or you need to let me know something, speak with me right after class or, even better, during office hours or through email.

- **Class videos.** If you get to class a little early, on most days you will find a video playing, usually having something to do with the material to be presented in that day's lecture. *Getting to class early to watch these videos is completely optional*; they will never contain required material that is not also presented during the formal lecture and/or by the textbook. The official class will never begin before the offical class start time. That said, many students in the past have found the videos to be a relaxing way to get introduced to the topics being discussed in the course, before class actually begins.

- **Asking questions.** Although our class is large, questions during lecture are encouraged – don't be afraid to put your hand up if something has confused you. In particular, the first ten minutes or so of class each week will be specifically set aside to answer any questions that you may have about the course or material.

- **Your professor's five "pet peeves".** Here are five things that *really* annoy me, so please do your best to not do them! The first two involve keeping our class time a focused, structured environment for learning, while the last three are more general issues.

  1. **Talking in class while I am lecturing.** This is my biggest single pet-peeve. Nothing bothers me more than this, so please refrain from *all* conversations with other students while the lecture is taking place.
  2. **Using a cell phone during class.** Please turn all cell phones off before entering the lecture room and store them out of sight. I do not want to *see* or *hear* any cell phones during class.

     → If you need to speak with another student or use your cell phone (for *either* text messaging or talking) during class, please quietly leave the lecture room and then quietly return when you are done.
  3. **Requesting an assignment extension.** Solutions to the weekly reading quizzes are posted on-line immediately after each quiz is due. It is therefore not possible to grant any assignment extensions for the reading quizzes. Furthermore, this course has built-in safeguards to prevent personal, unforeseen or "emergency" circumstances from adversely affecting your overall performance on these quizzes for the semester. Specifically, the lowest two homework scores (which may include an assignment on which you scored 0% – e.g., you were unable to take it) are not counted when computing your final course grade. Thus, you can completely miss up to two homework assignments (for any reason) and it won't hurt your grade. So please, do not ask for any extension to a reading quiz assignment.

4. **Emailing questions about the course that are answered in the Course Reader or Weekly Handouts.** I try very hard to have *all* relevant course information (e.g., assignment due dates, exam dates, etc.) contained in the Course Reader or, if it is of a late-breaking variety, in the updated Weekly Handouts that are available at the course website. It almost never happens that I *say* something in class about the course that is not also contained in the Reader and/or Weekly assignments. So please — especially if you miss a class — before emailing me a question, check to see that it is not already answered in the Reader or Weekly Handouts! (Note that emailed questions about astronomy are always welcome!)
5. **Leaving class before it is over.** I will lecture right up until the official end of our class period. I will never end class late, and will almost never end it early. The very end of each lecture is in fact the most important part, since all lectures end with a summary slide of the class. It is a *huge* distraction when students begin leaving with a few minutes to go; the shuffling and noise make it difficult for others to hear and see the final parts of the lecture. Thus, I request that you not get up to leave the lecture until it is over. If you are unable to stay for the entire lecture, then **please exit the room more than ten minutes before the end of the lecture**.

- **Classroom safety**. For all information concerning safety in the classroom, please read the information contained at San Diego State University's "Emergency Preparedness" website: http://bfa.sdsu.edu/emergency/ .

Summary of Course Policies

To ensure that there is no confusion (or surprises at course's end) I explicitly (re)state three of the more important course rules here.

- **There is no "extra credit" given in this course.** Focus all of your efforts on the "for credit" parts of the class (i.e., reading quizzes and exams)!
- **There are no assignment extensions, and "make-up" exams will be considered under only the most extraordinary (or otherwise unavoidable) and verifiable circumstances.**
- **No course grades of "Incomplete" (I) will be given**, except under *very* rare circumstances.

Strategy

And now, some time-tested tips for success in this class:

- **Do the reading**. At the start of each "week", you will be given a "Reading Guide" as part of the weekly handout, which includes the reading assignment for the week. The reading is generally due the following Tuesday. Do the assigned reading. The textbook contains the bulk of the material for which you are responsible in this course. That said, most students have found it very beneficial to...
- **Come to lecture**. Lectures are *based* on the text, but a conscious effort is made to present the material in a somewhat different manner from that given by the book. Everyone has a different preferred learning style; some find lectures the best way to learn the material, some find a textbook presentation most helpful, but everyone benefits from seeing the material presented more than one time and in multiple ways. By coming to lecture you will also see just what information is being emphasized – this is likely to be the same information that is stressed on your exams.
- **Use the weekly on-line reading quizzes to test your understanding of the material**. The on-line reading quiz questions are designed to be similar in form and content to those that will appear on your in-class exams. Since the quizzes are open book/note, there may be a temptation to simply read the questions and then "look up" the individual answers. Don't do this. Rather, *study* the material thoroughly before looking at the quiz; then, print out the quiz and take it off-line as though it is a test. After you've done this, *then* look up any answers that you are unsure about before submitting your quiz online. Use of this self-correcting technique will enable you to gauge how well you are mastering the material *before* facing it on an exam, and force you to engage in the material at a high level each week.
- **Get help**. Come to my office hours. Go to TA Help Room hours.[4] There are lots of opportunities to get individual assistance on the course material – use them!
- **Study**. Material is covered at a fairly rapid pace in class, and must be reviewed at home for complete comprehension. **It is expected that you spend at least 6 hours per week studying the material outside of class!** Don't wait until the last minute to prepare for an examination. This course presents a large amount of information, and it can really "catch up to you" if you do not stay current with the readings.
- **Visit the Blackboard website, http://blackboard.sdsu.edu**, when needed. There you will find all of the class handouts and assignments, in case you missed anything. All Powerpoint slides from the lectures are also posted there, usually within a day after the lecture is given.

[4] The TA Help Room location and hours will be announced during the second week of class.

Key Concepts, Terms, People and Ideas

Here is a list of some of the more important concepts, terms, people, and ideas in the approximate order that you will encounter them in the course. This list can be used as both an organizational aid during lectures (i.e., as each term is discussed, you can write notes next to it) and to help you prepare for exams. **Note, however, that this list is NOT exhaustive, and does NOT include "everything" for which you are responsible in this class.** It is provided merely to assist you during lectures, and to provide a framework for what is being covered in class. That said, a mastery of these terms will certainly go a significant way towards giving you a more complete understanding of the material covered by this course.

Star

Light year

Nebula

Earth

North Pole

South Pole

Equator

Latitude

Longitude

Sun

Horizon

Celestial sphere

Conceptual scheme

Zenith

Elevation

Celestial Poles

Celestial Equator

Polaris (North star)

Circumpolar

Planets

Ecliptic

Constellation

Asterism

Zodiac

Retrograde motion

Parallax

Cosmology

Geocentric

Heliocentric

Aristotle

Eclipse

Lunar eclipse

Eratosthenes

Plato

Epicycle

Claudius Ptolemy

Aristarchus

Solar System

Copernicus

De Revolutionibus

Telescope

Galileo

Astrology

Hipparchus

Precession

Law of Inertia

Galileo's Principle of Equivalence

Johannes Kepler

Isaac Newton

Kepler's Three Laws of planetary motion

Orbit

Ellipse

Perihelion

Aphelion

Astronomical unit

Period

Mass

Speed

Velocity

Momentum

Acceleration

Force

Newton's Three Laws of motion

Conservation of momentum

Gravity

Fundamental forces of nature

Escape velocity

Weight

"Weightless"

Asteroid belt

Asteroid

Volume

Density

Angular momentum

Newton's law of gravity

Inverse square relation

Properties of an ellipse: focus, semimajor(minor) axis, eccentricity

Newton's version of Kepler's Third Law

Moon

Angular Diameter

Solar eclipse

Corona

Solar nebula

Planetesimals

Terrestrial planets

Jovian (or giant) planets

Differentiation

Meteor/meteoroid/meteorite

"Shooting Star"

Comet

Greenhouse effect

Planet (most recent definition)

Electron

Proton

Neutron

Element

Atom

Periodic table of elements

Atomic notation

Ion

Apparent brightness

Luminosity (or power)

Inverse square law of light propagation

Standard candle (bulb)

Isotope

Speed of light

Reflection

Refraction

Dispersion

Spectrum

Spectroscopy

Continuous spectrum

ROYGBIV

Bright-line (emission-line) spectrum

Rarified

Dark-line (absorption-line) spectrum

Kirchoff's 3 laws of spectral analysis

Wave

Medium

Frequency

Wavelength

Electromagnetic waves

Electromagnetic spectrum: gamma, X, ultraviolet (UV), visible, infrared (IR), radio

Hα line

Doppler effect

Blueshift

Redshift

Radial velocity

Extrasolar planet

Proper motion

Arcsecond

Parsec

Parallax (formula)

Photon

Quantum mechanics

Ionization energy

Sunspot

Photosphere

Continuous spectrum

Conservation of Energy

$E = mc^2$

Strong force

Nuclear fusion

Thermonuclear reaction

Antimatter

Neutrino

Neutrino oscillations

Gas pressure

Radiation pressure

Hydrostatic equilibrium

Nucleosynthesis

Nuclear fission

Interstellar gas/dust

Main-sequence star

Stellar evolution

Red giant star

Low mass vs. high mass star

Mass loss

Planetary nebula

Binary star

Center of mass

White dwarf

Electron-degeneracy pressure

Chandrasekhar limit

Neutron star

Supernova

SN 1987A

Core-collapse supernova

Neutron-degeneracy pressure

Black hole

Neutron bombardment

Pulsar

Mass transfer

Accretion disk

Thermonuclear (Type Ia) supernova

Nova

Singularity

Event horizon

Schwarzschild radius

General theory of relativity

Principle of equivalence

Space curvature

Gravitational time dilation

Gravitational redshift

Spacetime

Photon sphere

Tidal force

Henrietta Swan Leavitt

Cepheid star

Edwin Hubble

Galaxy

Milky Way

Spiral galaxy

Elliptical galaxy

Irregular galaxy

Galaxy rotation curve

Dark matter

Supermassive black hole

Vesto Slipher

The Big Bang

Hubble diagram

Hubble law

Hubble constant

Cosmological principle

Cosmological redshift

Critical density

Accelerating universe

Cosmological constant

Dark energy

(Mileva Maric and Albert Einstein, c. 1902.)