Astronomy 0088: Stonehenge to Hubble

Course Syllabus

Monday, Wednesday, Friday at 11:00 AM in 343 Alumni Hall

Course Instructor

Dr. Andrew Zentner is the instructor for the course. I am a member of the Department of Physics and Astronomy at the University of Pittsburgh. The most effective way to reach me outside of class is through email. My email address is `zentner@pitt.edu`. My office is 401D on the fourth floor of Allen Hall. My campus phone number is 412-624-2752.

Please do not hesitate to contact me with **any** questions or concerns about this course. I want to work with my students to make this course interesting and **fun** and allow my students to learn a lot. All too often, students wait until the end of the semester to express concerns, but by that time I cannot change anything. There is **no** question too insignificant and there is no need to wait until it is too late to express a concern. Of course, I have to abide by University and Department rules and I have to work within the Physics & Astronomy curriculum, so I cannot accommodate all requests, but my intention is to make this course as fun and productive as possible. I am looking forward to a great semester.

The University of Pittsburgh CourseWeb site will be the primary means of communication throughout the class. It is the responsibility of the student to check the CourseWeb site often for updates and assignments.

Office Hours

I will hold regular office hours in 401D Allen Hall from:

- **1:00PM to 3:00PM on Mondays**
- **2:00PM to 3:00PM on Fridays**.

If you cannot make these times, please attempt to use the teaching assistant's office hours or recitation sections to have questions answered. Otherwise, please contact me and we can arrange to meet at another time.

I am happy to use office hours to help in any way I can. If you come to office hours for help with a homework problem, please be prepared to demonstrate that you have put some effort into the problem(s). In particular, be prepared to describe your thought process and the point at which you are stuck. **I will not** help with problems if you cannot first describe to me how you tried to solve the problem.

If you need further help or would prefer to seek help from a tutor, the University of Pittsburgh Department of Physics and Astronomy maintains a Physics Resource Room in 312 Thaw Hall that is staffed by tutors between 9AM and 5PM on weekdays throughout the semester. Please take advantage of this service.

Teaching Assistant

Ms. Sui Chi Woo (`email:suw11@pitt.edu`) is the teaching assistant (TA) for the course. Ms. Woo will run the recitation sections and will have independent office hours that she will post on the CourseWeb site.

Course Description

The word astronomy derives from the Greek and means the "order of the stars"; however, astronomy has come to be a vast field of study and it is impossible to even mention all of the major areas of Astronomy in any single course. This is a self-contained course for students not majoring in the physical sciences. The course is mostly descriptive in nature, but some of the lectures will make use of simple arithmetic and geometry because astronomy is a *quantitative science*. My primary goals are to cultivate an understanding of the scientific method that students can apply well beyond this course, develop an interest in Astronomy, and have fun!

The course aims to give an historical perspective to our current understanding of our place in the Universe. The course begins with a discussion of the earliest views of our Universe and the role of Astronomy in early civilization. The course proceeds with the development of our current understanding that we live on a planet in one of many solar systems, on the edge of a galaxy, containing billions of stars, that is but one of a hundred billion galaxies that we can potentially observe. The underlying theme through it all will be the process of scientific discovery and advancement. Understanding the nature of scientific discovery remains critically important in today's world and the process of scientific discovery is often described incorrectly in news, popular literature, and public debate.

The course takes us from humankind's early belief in an earth-centered Universe to a cosmic view of a sun-centered Universe that developed in the 16th and 17th centuries. From this, we continue through the time of Isaac Newton and the development of the modern scientific method and the first scientific theory. This is an effective marker of the beginning of modern, empirical science and is the beginning of the very closely-related fields of Physics and Astronomy.

The course continues with brief study of some simple, but practical topics in Astronomy. These include phenomena that can be readily observed with the unaided eye or a small telescope such as seasons, tides, phases of the moon, eclipses, the motions of the planets,

other solar system objects, constellations, stars, nebulae, and galaxies. We will briefly discuss the use of small telescopes for astronomical observations.

After this interlude, we continue with a discussion of our modern view of the Universe itself. Much of this will require some attempt to understand the scales involved in Astronomical investigations. For example, the distance between the Earth and the Sun, though vast compared to distances encountered in our everyday lives, is sixty billion times smaller than the distance accross our galaxy. We have observed other galaxies a hundred thousand times further away still! From the realization that the Sun is not the center of the Universe, humankind successively discovered that the Sun is not at the center of our Milky Way Galaxy, that our Milky Way Galaxy is not at the center of the Universe, that there is *no* discernible center of the Universe, and that we live in one Galaxy in an expanding Universe of more than one thousand billion galaxies. The culmination of this story is the modern triumph of the Big Bang Theory of the evolution of the Universe. This theory has become so well tested through specific empirical observations that it has become as close to an accepted fact as any scientific theory can be and provides a very reliable logical framework within which to think about our Universe. With this framework in place, the course will cover the detailed 13.7 billion year history of the Universe in which we live. Along with a discussion of the Big Bang Theory, we will discuss some topics of very active current research by professional astronomers including: Evidence for the existence of unfamiliar forms of matter called *dark matter* and *dark energy*; black holes at the centers of galaxies; planets around other stars; space exploration; and the search for life elsewhere in the Universe.

If there is a particular subject related to astronomical science that you find interesting, please let me know and I will try to cover it as part of the course if there is sufficient interest. In the past, students have requested lectures on black holes, supernovae, planets around stars other than the Sun, searches for extraterrestrial intelligence, space flight, global warming, solar power, and many other subjects. Remember, I want to you have fun and be interested in the subject.

Textbook

The official textbook for his course is *Discovering the Cosmos* by Robert Bless (1996). Please keep in mind that the historical portion of the class will follow this book rather closely. However, Bless' book is now fifteen years old and has become outdated in many respects related to our detailed understanding of our Galaxy and the Universe. My lectures will fill in these areas as needed, so it will be important to attend lecture and take notes. Some unpublished course notes will be provided to supplement the textbook. These, as well as my lecture slides, can be found on the University's Courseweb site. Please check

Courseweb often for updates. Please let me know if you have any problems retrieving this material and I will do my best to rectify the problem.

Some students prefer alternative texts, so I will give a handful of recommendations. *Universe* by Freedman and Kaufmann is a very popular introductory textbook that makes some use of mathematics. *21st Century Astronomy* by Hester, Burstein, Blumenthal, Greeley, Smith, and Voss (the 2nd edition authors are Hester, Smith, Blumenthal, Kay, and Voss) is a very good introductory book as well. This book provides a very careful and accurate description of the logic of the scientific method.

Lecture

Part of your grade will be based upon your participation in lectures. Beginning in the second week of class, all lectures will contain a series of clicker questions. You can earn 10% of your final grade by answering more than 80% of the clicker questions. The answers do not need to be correct in order to earn this credit, but it is in your best interest to take these questions seriously because they will be good practice for quizzes and exams. You can earn 5 additional percentage points toward your final grade for answering these questions correctly as follows.

- $>$ 50% correct earns 2% toward final grade
- $>$ 60% correct earns 3% toward final grade
- $>$ 70% correct earns 4% toward final grade
- $>$ 80% correct earns 5% toward final grade

Allegheny Observatory Visit

There will be numerous opportunities for students to make an evening bus trip to the University of Pittsburgh's own Allegheny Observatory. Allegheny Observatory is a facility with a rich history that has been used in a number of important astronomical discoveries by some of the leaders of astronomical science. Allegheny Observatory continues to be used for research today, primarily to observe planets around nearby stars (other than the Sun). Opportunities for a visit to the observatory will exist on Tuesday and Wednesday evenings starting February 1, 2011 (except March 8, 9, 15, and 16) until April 20, 2011. If it is clear, observations of celestial objects will be made. On cloudy nights an observatory tour will be given. **At least one trip to Allegheny Observatory is mandatory and will be counted toward your grade**. Students should schedule their trips with the TA, Ms. Sui Chi Woo. Buses depart in front of Allen Hall at 6:30PM in February, at 7:00PM in March,

and at 7:30PM in April. They return to campus about three hours later. Information regarding Allegheny Observatory trips are posted on the Department of Physics and Astronomy's web site at `http://www.phyast.pitt.edu/resources/observatory/index.php`.

Homework and Reading Assignments

Homework assignments will be assigned via courseweb almost every week, beginning the second week of class and will often be accompanied by reading assignments. These homework assignments are designed to emphasize the points being discussed during lecture and will make *excellent practice for the course exams and quizzes*. These homework assignments are *not* mandatory and will *not* be collected and graded. However, if you do not practice the homework problems, you will not do well on the quizzes in recitation or the in-class exams. The teaching assistent, Ms. Sui Chi Woo, will go over a selection of homework problems during the recitation sections so please make sure to ask the TA for help with any problems that you have trouble with if you aim to be well prepared for quizzes and exams.

Recitation Sections

Attendance at recitation is mandatory. Recitation sections will be used to review material, including the homework assignments, and to administer quizzes. Throughout the semester, there will be approximately 8 to 10 quizzes given during recitation. Your recitation grade will constitute 20% of your final grade in this course. Your recitation grade will be computed based on attendance and your performance on the quizes after *dropping your two lowest quiz grades*.

Exams

There will be three exams in this course, including the final exam, which will be given during the official final exam week. Students must bring their ID cards to exams. The use of books, notes or other written materials, computers, cellular phones, and all devices that can render documents, graphics, or connect to the internet are absolutely prohibited.

Each exam will cover approximately one-third of the course material. However, the material covered later in the course will often rely on the material covered earlier in the course, so it is difficult to do well on the later exams if you allow your understanding of the early material to deteriorate significantly. Each exam be comprised of approximately 40 to 60 multiple-choice or true/false questions. The focus of this course will be on a qualitative understanding of astronomical subjects and sound reasoning in addressing scientific questions. Each exam will be used to compute 20% of your final course grade. The three exams taken together will constitute 60% of your final grade in this course. Make-up exams will

only be given under extremely special circumstances, such as illness or University-approved travel, and will require a written confirmation from, for example, a medical doctor.

The exam dates are:

- **EXAM 1: Wednesday, February 16, 2011**
- **EXAM 2: Wednesday, March 23, 2011**
- **EXAM 3: FINAL EXAM WEEK**

Course Grading Policies

The final, letter grades for this course will be based upon a curve as specified for courses that fulfill the general education requirements of the College of Arts and Sciences. Keep in mind, absolute grades do not necessarily determine your final letter grade as it is your relative standing in the class that will determine your position "on the curve." The final grade will be computed from the different components of the course according to the following percentages.

- **15%** based on lecture participation as described above.
- **20%** based on recitation grade.
- **5%** based on trip to Allegheny Observatory
- **60%** based on the sum of grades on three (3) exams. Each exam is worth 20% of your final grade individually.

The curve will be such that *at least* 50% of students will receive a letter grade of **B-** or better. The following grades will be guaranteed.

- $>$ 90% of all available points earns a grade of A or better.
- $>$ 80% of all available points earns a grade of B or better.
- $>$ 70% of all available points earns a grade of C or better.
- $>$ 60% of all available points earns a grade of D or better.

Due to the curve, you will often be able to earn these grades with percentages lower than those quoted above.

The Department of Physics and Astronomy

As students at the University of Pittsburgh, you have access to a Physics and Astronomy Department that is well-recognized and is performing world-class research. The Department of Physics and Astronomy wants you to feel welcome. If you are interested in further

study of physics or astronomy please talk to your instructor or another faculty member. If you think you may be interested in getting involved in a career in Physics or Astronomy or in research in Physics or Astronomy, please feel free to contact the instructor or other faculty members.

Students with Disabilities

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services, 140 William Pitt Union, (412) 648-78901(412) 383-7355 (TTY), as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.