

ASTRON 0113

Introduction to Astronomy

Course Information

Class Code #: 12246

Credits: 3

Prerequisites: Exceptional high-school knowledge of physics and mathematics; freshman-level physics and calculus will be helpful

Meeting Time: Tuesdays and Thursdays, 1 PM – 2:15 PM, Thaw Hall room 104

(Note: The first floor of Thaw corresponds to the 4th floor of SRCC or the 2nd floor of OEH.)

Instructor Information

Lecturer: Prof. Jeffrey Newman

Office: 401-C Allen Hall

Office Hours: Monday 3:30-4:30 PM & Thursday 3:30-4:30 PM (or by appointment)

Email: jnewman@pitt.edu (email is generally the best way to contact me)

Phone: (412) 592-3853

Textbooks

An Introduction to the Sun and Stars, edited by Green and Jones

Dark Side of the Universe by Iain Nicolson

Note: The Green & Jones book may be purchased at a discount from the press:

<http://www.cambridge.org/us/catalogue/promotion.asp?nav=view&code=08ASTROPHY>

or from other sites:

[http://www.google.com/products/catalog?q=An+Introduction+to+the+Sun+and+Stars+\(Paperback\)+green+jones&hl=en&cid=12026369320508374433&sa=title#p](http://www.google.com/products/catalog?q=An+Introduction+to+the+Sun+and+Stars+(Paperback)+green+jones&hl=en&cid=12026369320508374433&sa=title#p)

These books will be supplemented with online materials; unfortunately, there are no textbooks that are well-suited to the level of ASTRON 113, complete, up-to-date, and affordable.

Course Description

This course will be an introduction to astronomy and astrophysics at the undergraduate level, intended for students that are majoring in the sciences. Broad familiarity with basic physical concepts such as force, energy, momentum, and temperature will be assumed, as well as college-level mathematics. Algebra, geometry, and trigonometry will be used throughout the course and will be needed to complete the homework problems and exams. Greater familiarity with introductory-level physics and, to a lesser degree, calculus will be very helpful, but is not absolutely necessary to complete any assignments or exams in this course. Contact me if you have any questions about your level of preparation.

If your intention is not to study astronomical concepts in some detail or if you are uncomfortable with a course focused on solving astrophysical problems then you should consider taking Astronomy 0087, 0088, or 0089; these courses are not designed for science majors and require minimal mathematics. If you took 0089 with me, I **strongly** recommend taking 0113 with someone else to minimize repetition and gain new perspectives; the course is taught every semester.

This is a self-contained course focusing on astronomical objects that lie beyond the solar system and the nature of the Universe as a whole. The first topic is the properties and life-cycle of stars including their birth, death and the formation of remnants such as black holes. Next, the nature and evolution of galaxies, including exotic objects such as quasars, will be discussed. Finally, the course will move on to the largest scales, including the origin and ultimate fate of the Universe.

There may be an opportunity to visit the University of Pittsburgh's Allegheny Observatory to tour the facility and, if weather allows, view the night sky through a telescope; bus transportation from the Oakland campus to the Observatory will be provided.

Course Objectives

The primary goals of this course are twofold:

- 1) to provide a basic knowledge of the Universe outside the Solar System, sufficient to prepare students for more advanced astronomy courses; and
- 2) to help students gain skills in solving scientific problems, including the use of approximation techniques and other methods of obtaining rough solutions.

At the end of the course, you should also be able to explain, among other things:

- How we can measure the properties of distant stars and galaxies using observations from the Earth and space
- Why the Sun shines, and why it will not do so forever
- How the Sun and other stars form and die

- Where black holes come from, and how they bend space and time
- How the Milky Way Galaxy we live in is similar to (or different from) other galaxies
- Why we believe many galaxies have black holes at their center
- What the main constituents of the Universe are, how it began, and what its ultimate fate will be

Course Structure

In recent years, Physics and Astronomy education research has found in a variety of contexts that the most lasting learning comes not from lectures, but from active engagement with material. The course will employ a number of techniques that have proven effective in the past:

- 1) Just-in-Time Teaching: There will be pre-class questions based on the reading or setting the stage for classroom material, due at 10 PM the night before each class. Lectures will generally cover only the material students are having the most difficulty with, based on these questions.
- 2) Lecture questions: Lectures will be broken up by multiple-choice questions that everyone responds to, helping me tell if points are getting across, helping you to know if you are up to speed with the class, and also stimulating small-group discussions.
- 3) Group problem-solving: I expect that a significant fraction of class time will be devoted to students working together in groups of 5-7 to solve problems of similar level to the homeworks (in some cases including homework problems).

Students are expected to have read the relevant sections of the textbook or online readings (listed on Courseweb) before class. Lectures and these activities are a supplement to the textbook, not a replacement. The goal is not for you to understand everything after reading, but you should come to class ready to ask questions about the parts that are unclear!

Tentative Grade Weighting

I expect that grades will be weighted as:

10%	Pre-class assignments
10-40%	Homework
25-35%	Midterm
25-35%	Final exam
0-20%	Group work

The final grading scale will be curved to reflect actual class performance; in accordance with department guidelines, roughly half the class should receive a grade of B- or above.

Pre-class assignments:

There will be a set of questions posted on Courseweb to be answered by 10 PM the night before each class. These questions will be graded for completeness but not correctness; it is **essential** that you answer questions before each class for just-in-time teaching techniques to work.

Homework:

There will be roughly 10 homework assignments during the semester, consisting of a variety of astrophysical and approximation problems. If a grader is available, homework will be given greater weight and a greater fraction of homework problems will be graded.

Exams:

Exams will consist of a variety of problems broadly similar in nature to those on homework assignments or done in class.

Students are allowed (and encouraged) to collaborate in finding solutions to homework assignments, but each student should present their own reasoning and write up their own solution; collaboration on exams is strictly forbidden.

In both homeworks and exams, the focus will be on having the correct reasoning. No credit will be given for a correct answer without the reasoning being clearly explained. A great deal of the credit for a problem may be given if the reasoning is correct, but the numerical answer is incorrect for one reason or another. For all problems please give a detailed statement of the problem and give a detailed explanation of your reasoning in order to get full credit for the problem. Occasionally, you may find an answer that is obviously incorrect. For example, say you derived the distance to the sun to be three miles. In such a situation, you can still get partial credit for the problem simply by recognizing that the answer obviously does not make sense and explaining why the answer is manifestly incorrect. To ensure maximum credit, you should follow the problem-answering method we will go over in class.

Group work:

Depending on how the course progresses, there may be a group project for credit, and/or students may receive credit for participating in their groups during class.

Expectations

It will be vital for you to study the material at home, doing reading and pre-class assignments beforehand so that class time can be used for group work and mini-lectures. I expect you to attend all classes and to come prepared for active participation; failing to do so will not only be sure to impair your performance in the class, but also harm the other members of your group.

Following the School of Arts and Sciences' guidelines, I expect that you will study for class and work on class assignments for about 90 hours over the course of the term outside of class meetings (about 6 hours a week).

You will work in groups to discuss readings and solve problems. You will be an active participant in your group, and conduct all assignments as directed by your group leader (which will change daily). The classroom will be a safe environment for discussing and challenging ideas and concepts. The students and the instructor are expected to treat each other with respect at all times.

You can expect me to come prepared to give mini lectures, to explain difficult concepts, to assist the groups, and to assign relevant readings and homework problems. I will be a willing listener and advisor in helping you succeed in this class, and with other career questions you might have. You may expect me to be available outside of class to give additional support.

I want this class to be interesting, informative, useful, and fun. I am always open to suggestions and willing to try to modify the topics, etc. to accommodate the interests of the class.

Tentative Calendar

Week begins:	Planned material
8/31	Introduction; Astronomy as a Science; Problem Solving
9/7	Gravity
9/14	Special and General Relativity; Black Holes
9/21	Light (Ch. 1)
9/28	The Sun (Ch. 1 & 2)
10/5	Stars (Ch. 3, 4, 6)
10/12	No class 10/13 ; Allegheny Observatory Tour evening of 10/15
10/19	Where stars come from (Ch. 5) ; Midterm exam
10/26	The lifecycle of stars (Ch. 7), Stellar explosions and remnants (Ch. 8 & 9)
11/2	Ordinary Galaxies
11/9	Active galaxies; Large-Scale Structure of the Universe
11/16	Cosmology (<i>Dark Side of the Universe</i>)
11/23	Cosmology ; no class 11/26
11/30	Cosmology
12/7	Life in the Universe; Final review
12/14	Final examination, December 14, 2 PM

Students will be expected to have read the relevant sections of the textbook before class.

The schedule and procedures in this course are subject to changes by the instructor which will be posted on the ASTRON 113 Courseweb site (and announced in class in the case of major changes). Exam dates are not expected to change, but the exact material covered will be adjusted according to the actual pace of the course.

The Department of Physics and Astronomy

As students at the University of Pittsburgh, you have access to a Physics and Astronomy Department that is highly 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 or research in physics or astronomy please talk to me.

You may make use of the undergraduate lounge *off* of the mail room on the second floor of the Old Engineering Hall. This is a good place to meet with classmates to discuss problem sets and course material. You might also meet physics majors here that can help you, discuss other classes with you, or inform you about the major program. The Department also hosts a doughnut and coffee hour every Wednesday at 4PM in Allen Hall which is designed to encourage discussion. The University of Pittsburgh's Astronomy research group hosts seminars on topics of current interest in astronomy and astrophysics every other Friday at Noon in 319 Allen Hall. The talks are typically at an advanced level, but eager students can learn a great deal about contemporary astronomy and astrophysics by attending.

Courseweb and Other Resources

The University of Pittsburgh provides a web based resource called *Courseweb*, which is a portal to web sites for individual courses. A *Courseweb* site for this course has been created and from there you may view announcements, send email to the instructor or the TAs, and download course material such as the syllabus and lecture slides. **Reading and homework assignments will all be announced on Courseweb.** To access *Courseweb* go to <http://courseweb.pitt.edu/> .

Use your Pitt email username and password to login to Courseweb. If you have forgotten your username and password or need to set up an account, contact the help desk at 412-624-4357, or 4-HELP. Once you have logged into the system simply click on the link for this course to access the available material.

The Department of Physics and Astronomy provides free assistance for all students. The **Physics Exploration Center** allows students to operate some simple experiments and demonstrations. Within the Exploration Center is the **Physics Help Room** staffed with TAs who can answer homework related questions, explain basic concepts and help you with the math. This is a free

service and you are encouraged to use it. The Physics Exploration Center and the Physics Help Room are both located in Thaw 312. In addition, tutoring is available through the Academic Support Center (WPU 311).

Academic Integrity

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

Disabilities

If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and the Disability Resources and Services no later than the 2nd week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. To notify Disability Resources and Services, call 648-7890 (Voice or TTD) to schedule an appointment. The Office is located in 216 William Pitt Union.