Astronomy H161 – An Introduction to Solar System Astronomy

Winter Quarter 2009

Syllabus

Lectures: MTWRF, 9:30-10:18am, 5024 Smith Laboratory (SM 5024)

Professor: Scott Gaudi

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Office Hours: Wed, Fri 11:30-12:30, or by appointment

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Recommended Textbook:

21st Century Astronomy (2nd Edition), by Jeff Hester, et al.

Note that this book is recommended but not required. If you are not planning on taking Astronomy 162, consider buying The Solar System by the same authors (ISBN-10: 0-393-39009-2), which is just the first half of the full textbook repackaged. It will save you money.

If you are planning on taking Astronomy 162, I recommend buying the full textbook, as just buying the first and second halves as separate books will cost much more than the full edition. If you can find a copy of the paperback edition without the student CD-ROM (which we will not use), you can save a little money.

Course Web Page:

`http://www.astronomy.ohio-state.edu/~gaudi/AST161H/index.html`

Course Description

Astronomy 161 is an introduction to modern astronomy, with an emphasis on the solar system. We will begin with an exploration of the historical development of astronomy to trace the path by which we have come to our present understanding of the Universe, building up along the way the basic toolkit of physical concepts that we will need for our later discussions. The second half of the course will be devoted to an overview of modern solar system astronomy, with particular attention paid to the constituents of the solar system, comparative planetology (structure, surfaces, & atmospheres) and the history and evolution of the solar system.

Course Objectives

The primary objectives of this course are to (1) provide a fundamental knowledge of astronomy of the solar system, and its relation to allied disciplines, in particular physics, (2) show how the struggle to understand the motions of the stars, sun, and planets led to the birth of modern science, and (3) provide a basic understanding of the planets including the Earth as a planet.

Course Outline

- Part 1: Introduction/Motions in the Sky (Jan 5, 6, 7, 8, 9)
- Part 2: Greek Astronomy (Jan 12, 13, 14, 15)
- Part 3: Revolution and the Birth of Modern Science (Jan 16, 21, 22, 23)
- Part 4: The Physics of Astronomy (Jan 26, 27, 28, 29, 30, Feb 2, 3, 4)
- Part 5: The Earth and the Moon (Feb 5, 6, 9, 10)
- Part 6: Solar System Overview and the Inner Planets (Feb 11, 12, 13, 16, 17)
- Part 7: The Outer Planets (Feb 18, 19)
- Part 8: Small Bodies, Debris, and the Origin of the Solar System (Feb 20, 23, 24, 25, 26, 27, Mar 2)
- Part 9: The Search for Other Worlds and Life in the Universe (Mar 3, 4, 5, 9, 10, 11, 12)
- Part 10: Death in the Universe (Mar 13)

January 19 is a holiday (Martin Luther King, Jr.)

January 20 and March 6 will be full period tests.

January 21 and March 5 there will be guest lecturers.

Basic Approach

My primary teaching method will be to guide you to figure things out about the solar system for yourselves using whatever data might be available. In the beginning, we will focus on what can be learned from naked-eye observations (such as the size of the Earth or the distance to the Moon). Later we will include data taken by sophisticated satellites. However, our aim will always be the same: to learn how to make inferences about the natural world from carefully chosen observations. In other words, to learn how scientists think. The main vehicle of this process will be classroom discussion. While I will present some formal lectures of the traditional sort, most of the class time will be spent by having the class figure out one astronomical problem or another. **Hence, do not read the book on a given topic until after the class has already finished discussing that topic. Otherwise you will spoil the fun for yourself and others.**

Homework Assignments

There will be six homework assignments during the quarter. The questions are open book, open notes, open discussion. Homework will be due on the following dates:

Homework 1: Due Monday, January 12 (Part 1) and Friday, March 13 (Part 2)
Homework 2: Due Wednesday, January 21
Homework 3: Due Monday, February 2
Homework 4: Due Monday, February 9
Homework 5: Due Monday, February 23

Homework 6: Due Monday, March 2

Collectively the homework will count for **25%** of your final grade. Most of you will find these problems to be very difficult at the beginning, but will get the hang of doing them within a couple of weeks. They are designed to get you thinking about the course topics in an active way. Learning how to do the homework problems will be crucial for taking the exams! Thus, while you are free to cooperate with each other on the homework, you must make certain that you understand how to do the problems yourself and, of course, hand in your own work.

Homework is due <u>in class</u> on the due date and no late homework will be accepted, except for legitimate, documented emergencies.

Term Paper

Your term paper can take the form of

1) Reading a book and writing a critical review, or
2) Researching some topic in the history of astronomy (could be from ancient times or just the past couple of years) and seeing how ideas on the topic evolved with time or how the idea is treated in introductory textbooks, or
3) Another project of your own design.

The paper must list all sources used; all quotes should be credited to the source and enclosed in quotation marks. The due dates for completion of the term paper are:

January 16: Hand in a short description of your proposed project.
February 16: Hand in first version of your term paper.
February 23: Get back first version with comments.
March 13: Hand in final version.

The final report must be no longer than 10 pages, double-spaced, 12 point font. Grades for the term paper will be based on: logic displayed, insight displayed, how convincing the writing was, how much work appeared to have gone into it, the significance of the report, and the writing style. The term paper is worth **25%** of your final grade.

Book Review: If you choose to do a book review, some topics you should include are: What level is the book aimed at? Is it effective at that level? What are the main points the author tries to make and how well does s/he succeed? Are the explanations clear and compelling? Was the writing style appropriate?

A short list of few possible books is given below. A longer list of older books is attached as well. Feel free to choose another if you wish. Some books are short; if you choose *Voyage to Jupiter* then also do *Voyage to Saturn*. If you pick *Satellites of the Outer Planets* or other book with about 200 pages, then unless it is fairly technical, apply what you have read by, for example, seeing how it agrees or disagrees with the textbook, or seeing if you think the textbook author made the right choices of what topics to emphasize, or comparing the latest thinking with what was believed for example before spacecraft made close-up observations.

Possible book titles (all should be available in the Science and Engineering Library)

- *Is Pluto a Planet?* by David Weintraub, Princeton University Press, 254 pages

- *Here Be Dragons: The Scientific Quest for Extraterrestrial Life*, by David Koerner & Simon LeVay, Oxford University Press, 264 pages
- *Rare Earth: Why Complex Life is Uncommon in the Universe*, by Peter Ward & Donald Brownlee, Copernicus, 333 pages
- *New Worlds in the Cosmos: the Discovery of Exoplanets,* by Michel Mayor & Pierre-Yves Frei, Cambridge University Press, 248 pages
- *World Unnumbered: The Search for Extrasolar Planets,* by Donald Goldsmith & Jon Lomberg, University Science Books, 237 pages
- *Beyond Pluto: Exploring the Outer Limits of the Solar System,* by John Davies, Cambridge University Press, 233 pages

Research on a topic: There are an enormous number of possible topics that you could research relying on several different books and/or articles. Some examples are listed below, but you could choose others.

- Trace the history of ideas about the existence of simple and/or complex life on Mars.
- Trace the history of ideas about what might exist beyond the orbit of Neptune.
- What is the evidence that a few meteorites have come from Mars?
- Trace the evolution of the idea that a giant impact caused the extinction of the dinosaurs, or summarize the arguments for and against this idea.
- What is the faint young sun paradox, and what are the possible resolutions to this paradox? What is the most likely resolution to this paradox and why?
- How did the surface of the Moon compare with what was expected before the first spacecraft went there? What were the scientific accomplishments of the Apollo program?
- The competing ideas for the origin of the solar system over the past centuries were that planets resulted from a close encounter or impact with the Sun, or that they formed from matter left around the Sun as the Sun formed. Follow the popularity of the two ideas over time, pointing out why preferences changed.
- How has the accepted wisdom of the nature and origin of comets changed through history?
- Trace the origins of the science of astrobiology, and in particular document the basic philosophical, cultural, and technological milestones that had to occur in order that it could develop into a mainstream field of scientific inquiry.

In-Class Tests

There will be two in-class tests, scheduled for the following dates:

In-Class Test 1: Tuesday, January 20
In-Class Test 2: Friday, March 6

The tests will be held at the normal class time and you will have the entire class time to take it. Both in-class tests and the final exam will be closed-book and closed-notes.

The in-class tests will cover the material in the lectures and readings since the previous test, whereas the final exam will be comprehensive, covering the entire quarter. These tests will have a similar format to the homework problems, although will generally be somewhat less challenging. The primary goal is to test your understanding of the general concepts covered in the class, rather than specific facts. The questions require putting ideas together and drawing correct conclusions.

The two tests together will count as **25%** of your final grade.

Final Exam

The Final Exam will be on **Wednesday, March 18 from 9:30-11:18am in the classroom (5024 Smith Lab).** Attendance at the Final Exam is mandatory. The final will be **comprehensive**, covering all lectures, and will have the same format as the in-class tests, only it will be longer. It is worth **25%** of your final course grade.

No makeup final will be offered.

If you miss the final exam, you will be given an incomplete (I) with an alternative grade equal to getting a zero on the final, and have to make it up during Spring Quarter 2009 to avoid the alternative grade.

In keeping with official University policy, early finals will **not** be available for those persons who wish to depart early for the break. Please plan ahead and make your travel plans accordingly.

Grading Policy

- The six homework assignments will collectively account for **25%** of your grade.
- The two in-class tests together count for **25%** of your grade.
- The term paper will count for **25%** of your grade.
- The final exam will be cumulative, covering all material from the class. It accounts for **25%** of your grade, and must be taken by all students.

Lectures and Attendance

Lectures will be MTWRF 9:30-10:18am, in 5024 Smith Laboratory on the OSU main campus in Columbus. The daily lectures are your primary resource for this course. While daily attendance is not required, it is very strongly encouraged. **You are unlikely to do well in this course if you do not attend the lectures.** The book serves as a useful resource only. We will not cover all of the topics in the book and I will supplement the book with additional material that is not covered in the book. Furthermore, I will generally not make any lecture notes available, as the interactive nature of the lectures cannot be encapsulated on paper.

Related Readings in 21st Century Astronomy

Because introductory astronomy textbooks designed for non-majors are rarely organized exactly the same as our courses, we will not strictly follow the order of topics in the book. You can expect to jump around some as the course progresses. As such, instead of specific reading assignments, each section of the course will have reading suggestions listed on the class website. However, not all topics in this course are covered by the book, and similarly not all topics covered in the book will be discussed in class. You are only responsible for the contents of my lectures.

Students with Disabilities

Any student who feels that he or she may need an accommodation based on the impact of a disability should contact Professor Gaudi to discuss their specific needs. We will rely on the Office of Disability Services at OSU to verify the need for accommodation and to help develop the appropriate strategies. Students with disabilities who have not previously contacted ODS are encouraged to do so by visiting the ODS website (www.ods.ohio-state.edu) and requesting an appointment.

Academic Misconduct

All OSU professors are required to report suspected cases of academic misconduct to the Committee on Academic Misconduct. See the University's Code of Student Conduct for details. The most common forms of misconduct in classes such as this one is copying from another student's exam. All cases will be investigated following University guidelines.

Classroom Etiquette

To help establish and maintain a courteous, distraction-free learning environment in our classroom, I ask that all students please observe the following basic rules of behavior during lectures and exams:

Use of cell phones and pagers is prohibited.

This includes using cell phones for instant messaging, email, web, pictures, etc. When in class, all cell phones and pagers must be **turned off** (i.e., not in a standby or "silent ring" mode).

Use of laptops and networked devices is prohibited.

Surfing the web, instant messaging, reading email, or typing notes on a keyboard during class is very distracting to those around you. When in class, all laptop computers and networked devices (e.g., PDAs) must be turned off and put away. The only exceptions are approved devices for enhancing sound or vision for the hearing/vision impaired.

Please do not start packing up until class is completely over

Nothing is more rude or distracting than the noise of notebooks closing and jackets and backpacks rustling while the professor is trying to finish up. I'll be very clear when we're done, and I work very hard to stay on time, so please wait until I get to the end.

If you come late or have to leave early, please sit near the back of the room.

This will make your late arrival or early departure less disruptive for your fellow students.

No conversing during lectures.

Please respect your fellow students and do not carry on conversations during class.

Your cooperation in observing these rules is greatly appreciated.

GEC Goals and Objectives

Astronomy 161 is a General Education Curriculum (GEC) Physical Science course in the Natural Science category. The goals for this course include:

- Understanding the basic principles and central facts of astrophysics, and their relation to other ideas in the physical and biological sciences.
- Understanding how we discovered the important principles and facts of astrophysics, thus understanding key events in the history of science both as events in human history and as case studies in the methods of science.
- Investigating the relationship between science and technology,

- Understanding the social and philosophical implications of major scientific discoveries.

Learning Objectives:

In Astronomy 161, the specific learning objectives to achieve these course goals are:

- To investigate the basic facts, principles, theories, and methods of modern science as practiced in astrophysics.
- To learn the basic observable phenomena of astronomy, and how these have had both practical applications (time keeping and calendars), and played a key role in advancing our understanding of the Universe.
- To learn important events in the history of astronomy, particularly the development of our understanding of the nature of the Solar System and the discovery of the physical laws that govern its motions, formation history, and evolution.
- To explain the role of modern technology in the investigation of astrophysical phenomena, and the crucial role played by technological advances in extending our knowledge of the Universe.
- To explore how discoveries in astrophysics have implications for how we have come to view our place in the Universe, and by comparing the Earth to other planets in our Solar System provide a physical framework for understanding the possible impacts of our activities on the Earth.