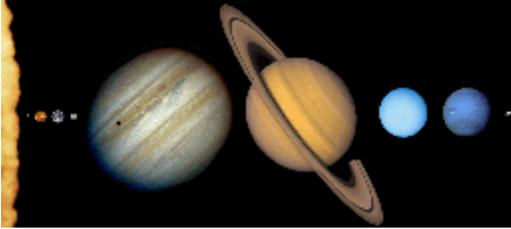


ASTR430: The Solar System, Fall 2023



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Office Hours: After class or by appointment.

Textbook: [Fundamental Planetary Science](#) by J.J. Lissauer and I de Pater

Webpage: <http://www.astro.umd.edu/~hamilton/ASTR430>

ASTR430 Course Description

I have two main objectives in teaching ASTR430. First, I want you all to gain a basic knowledge of the Solar System: its origin, the interesting and diverse worlds that orbit within it, and the remnant debris left over from its creation. We will learn about the history of Planetary Science as it grew from one practitioner in the 1940s to over 1500 active scientists worldwide today and its meteoritic rise due primarily to the spectacular results of the U.S. and Soviet space programs. We will see the results of titanic collisions and mammoth volcanoes, peer through the murky atmospheres of worlds whose surfaces we can barely see, and speculate on Solar System niches where extraterrestrial life may exist. Scientists working in Planetary Science come from many fields including geology, chemistry, physics, astronomy, mathematics, fluid dynamics, and biology. Similarly, the class textbook, [Fundamental Planetary Science](#), utilizes results from a wide diversity of different sciences. One of my primary goals in ASTR430 is that you thoroughly read and understand all of the chapters from this excellent textbook. We will cover about a chapter per week and, to help motivate you to keep up the reading pace, there will be short quizzes on the reading every other week. We will also spend at least 15 minutes per lecture discussing the reading. This will work best if you all bring questions and comments on the reading to class so that you can contribute to the discussion.

My second main objective in ASTR430 is to help you develop your problem solving skills. I assume that you all have had at least one year of college Physics, and have some familiarity with differential equations. Having the necessary prerequisites for this class, however, does not necessarily make you a good problem solver. There are a number of excellent techniques that you can and should use to improve your ability at problem solving (see [Hints for Problem Solving](#)). These techniques are powerful and general, and can be used in your other classes as well as this one. We will spend the semester working on your problem solving skills, which you will have a chance to practice on homework assignments, and to perfect on the midterm and the final exam. Depending on student interest, we may also have informal problem solving sessions prior to homework deadlines.

Assignments and Grading

There are several types of assignments in ASTR430 listed below.

- **Homeworks:** The seven homework assignments are meant to help you improve your problem solving skills. The problems will cover aspects of planetary physics and will emphasize using the basic conservation laws of Physics (Energy, Momentum, and Angular Momentum).
- **Quizzes:** The seven quizzes will cover material from the assigned reading only. Quizzes occur roughly every 2 weeks and typically will cover two chapters from the book. The intent of the quizzes is to help me determine whether you have read and understood the material in the textbook.
- **Midterms:** The two midterms will emphasize problem solving and will also include questions relating to the reading, lectures, and class discussions. Problems will be similar to, but easier than, those on the homework assignments.
- **Final:** The two-hour final exam will be similar in format to the midterm. It will be cumulative, covering the whole course, but with emphasis on the material after the last midterm.
- **Presentation:** You'll each have a opportunity to read and present to the class material from one of the book chapters. Public speaking can be scary, but is an extremely important life skill. The idea here is to practice this skill in a safe non-threatening space.
- **Participation:** Between 15 minutes and 1/2 hour of each class will be devoted to a class discussion of the assigned reading. These discussions are more fun, more interesting, and more relevant if you take an active role in contributing to them. Maximum participation scores will be awarded to students who keep up with the reading, regularly bring interesting topics and questions to class, and actively help to shape these discussions.

I grade on a point scale with different assignments weighted as shown in this table.

ASSIGNMENT	Homework	Quizzes	Midterms	Final	Presentation	Participation	Total
POINTS	210	105	150	150	75	60	750

The number of points required to get a given grade will depend on the class average. In addition, getting 90%, 80%, 68%, 55% of the total possible points guarantees at least an A, B, C, D, respectively. You can monitor my current estimate of your grade as the semester progresses from the *What's my Grade Right Now?* link on the class webpage.

Late or Missing Work

If you are going to miss a day of class when there is an in-class assignment (quiz, midterm, final), it is essential that you let me know in advance. No makeup work is allowed after the deadline without my prior approval.

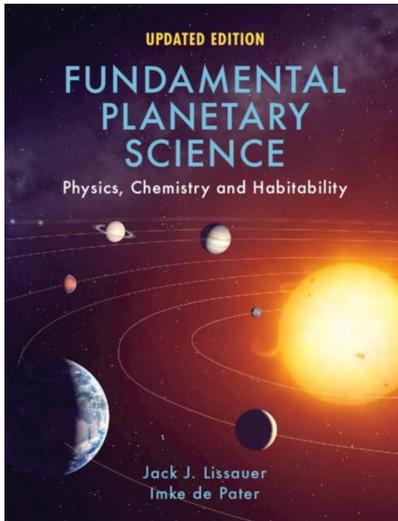
- **Homeworks:** Homeworks must be in by the due date. If you will be away that day, please slip it under the door to my office before the deadline or have a friend hand it in for you.
- **Quizzes:** Makeup quizzes will be available to worthy students the day before the usual date.
- **Midterm and Final:** Please make every effort to be in class for these important exams. In exceptional cases, I will arrange for a makeup exam.

Missing work gets a zero - not recommended.



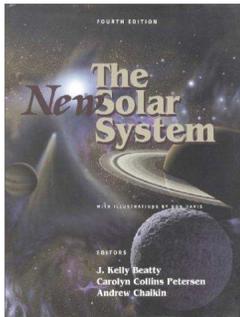
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ASTR430 Textbooks



Required:

Fundamental Planetary Science (J.J. Lissauer and I. de Pater). An excellent quantitative introduction to the physics of the planets. About \$70. Errata for the [2013 edition](#) and [updated 2019 edition](#).



Recommended:

The New Solar System (J.K. Beatty and A. Chaikin, Eds., 4th Edition). \$10-\$20 second hand.

Excellent qualitative introduction to planetary science. Descriptive chapters are each written by experts in the field. Published in 2000, so somewhat out of date but still a good value.

Good General Solar System Information:

- [The Nine Planets](#).
- [NASA Photo Gallery](#).



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ASTR430 LECTURE SCHEDULE

Lecture Date	Lecture Topic	Reading
Tue. Aug. 29	Introduction, Problem Solving Techniques	Ideally, do the reading before the lecture! Come prepared to talk about the reading in class.
Thu. Aug. 31	Introduction, Problem Solving Techniques	Preface, Chapters 1, 3.2 and look over Appendices A-F
Tue. Sep. 5	Atmospheres: Density and Thermal Structure	Chapters 5.1, 5.2
Thu. Sep. 7	Atmospheres: Composition	Chapter 5.3, 5.4
Tue. Sep. 12	Atmospheres: Climate	Chapters 5.5, 5.6
Thu. Sep. 14	Atmospheres: Climate	Chapters 5.7, 5.8; HW #1 due
Tue. Sep. 19	Planetary Interiors	Chapter 6; QUIZ #1
Thu. Sep. 21	Planetary Surfaces	Chapter 6
Tue. Sep. 26	Impact Cratering	Chapter 6
Thu. Sep. 28	Interplanetary Medium	Chapter 7; HW #2 due
Tue. Oct. 3	Planetary Magnetic Fields	Chapter 7; QUIZ #2
Thu. Oct. 5	MIDTERM	Chapters 1, (some of 2-4), 5-7; Homeworks 1,2; Quizzes 1,2
Tue. Oct. 10	Jupiter and Saturn	Chapter 8
Thu. Oct. 12	Uranus and Neptune	Chapter 8; HW #3 due
Tue. Oct. 17	The Moon and Mercury	Chapter 9; QUIZ #3
Thu. Oct. 19	Venus and Mars	Chapter 9
Tue. Oct. 24	Planetary Satellites	Chapter 10
Thu. Oct. 26	Planetary Satellites	Chapter 10; HW #4 due

Tue. Oct. 31	Planetary Satellites	Chapter 10; QUIZ #4
Thu. Nov. 2	MIDTERM	Chapters 6-10; Homeworks 3,4; Quizzes 3,4
Tue. Nov. 7	Meteorites	Chapter 11
Thu. Nov. 9	Meteorites	Chapter 11; HW #5 due
Tue. Nov. 14	Class Presentations	Chapters 12, 14, 16; QUIZ #5
Thu. Nov. 16	THANKSGIVING!	
Tue. Nov. 21	Planetary Rings	Chapter 13
Thu. Nov. 23	Planetary Rings	Chapter 13; HW #6 due
Tue. Nov. 28	Planetary Formation	Chapter 15; QUIZ #6
Thu. Nov. 30	Planetary Formation	Chapter 15
Tue. Dec. 5	Planetary Formation	Chapter 15
Thu. Dec. 7	Review for Final Exam	All Chapters; HW #7 due; QUIZ #7
Mon. Dec. 18	FINAL EXAM: 1:30pm-3:30pm, ATL2428	All Chapters, Homeworks, and Quizzes!



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Problem Solving Hints

This page is meant to give you advice to help you improve your problem solving skills and your homework writeups. I expect you to follow these points for ASTR430 homeworks, and encourage you to employ them in your other science classes as well.

- **Write up Neat Homeworks.** Take pride in your homework writeups and do the best job that you can on them. Take the time to solve the homework problems roughly on scratch paper, and then copy them over neatly, filling in additional details on your final copy.
- **Show Your Work.** Give written descriptions of what you are doing, and why you are doing it. This is often especially useful at the beginning of a problem where it will force you to think about the problem physically and formulate your approach mathematically. Descriptions will also maximize the chances that I can follow what you have done in a derivation (especially if you go off on a wild tangent!) and will help me to give you constructive comments on your work. Give enough detail, and show enough mathematical steps, that students less advanced than you could understand your derivation!
- **Check Units.** Any equation that you write must be dimensionally correct. Check your equations occasionally as you go through a derivation. It takes just a second to do so, and you can quickly catch many common errors. Remember this general rule: in all physically valid solutions, the argument of all functions (e.g. trigonometric functions, exponentials, logs, hyperbolic functions, etc.) must be dimensionless. Taking the cosine of something with units of mass or length makes no physical sense.
- **Check Limits.** Check all of your final answers and important intermediate results to see if they behave correctly in as many different limits as you can think of. Sometimes you will know how a general expression should behave if a particular variable is set to zero, infinity, or some other value. Make sure that your general expression actually displays the expected behavior!
- **Take Advantage of Symmetries.** Symmetries are fundamental in physics (and astronomy!). Problems can have symmetry about a point (spherical symmetry), a line (cylindrical or axial symmetry), or a plane (mirror symmetry). You can use symmetries in two ways: 1) to check your final answer to a problem or, with a little more effort, 2) to simplify the derivation of that final answer. As an example, time-independent central forces (like gravity) have spherical symmetry because the force depends only on the distance from the origin. In this case, spherical symmetry means that once we find one solution (e.g. a particular ellipse for gravity), all other possible orientations of this solution in space are also solutions.
- **Use Common Sense.** Usually you will have some physical insight into how the solution to a problem should look. Compare your derived solution to a problem to what you expect from physical insight. Trust your instincts! If a derived equation or numerical value looks funny, go back through the derivation and look for an error. If you can't find an error, make a note of your concerns near your final solution and I will comment on them.
- **Get Help from Others.** Work on the homework problems on your own first and get as far as you can on them. This is the best way to improve your problem solving skill and prepare for in class tests. But by all means get help from other people (other students, or me) when you are stuck! By trying the problems first, you will be able to ask more intelligent questions and better understand the ideas of other students and/or the hints that I might give.

- **Go over Homework Solution Sets.** When you get homeworks back from me, go over the solution sets and your corrected homework together. Use the solution set to see how to get past points where you were stuck, and make sure that you could easily do a similar problem if given the chance, say on a midterm. Even if you get a particular problem correct, there is always much to learn by following through someone else's solution. I spend a lot of time writing up solution sets so that you can all improve your problem solving abilities. Take advantage of the opportunity!
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