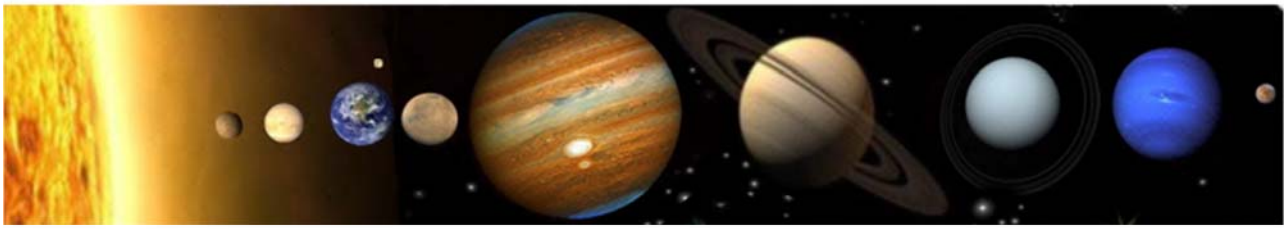
ASTR-202: Exploration of the Solar System
Fall 2017 Syllabus



Instructor:	Eugene H. Levy
Physical Space:	318 Herman Brown Hall; 713-348-4121
Virtual Space:	Email: ehl@rice.edu | Home Page: http://ehl.web.rice.edu
Class Website Portal:	CANVAS [202 001 F17]
Lectures:	Tuesdays & Thursdays, 9:25 - 10:40 am Herman Brown Hall 427
Office Hours:	Following Thursday class & flexible by appointment

The course is intended to satisfy Group III distribution requirements. Students majoring (or intending to major) in astronomy/astrophysics should consider alternative astronomy courses, such as ASTR 350/Introduction to Astrophysics-Stars, which provide credit toward the major degree, though they are, of course, welcome here as well.

Course Objectives

We humans are a cosmic phenomenon, born of the processes that shaped the cosmos during the time since what we think of as the start of our observable universe in the so-called Big Bang event, which apparently occurred about 13.8 billion years ago. Most immediately, we are a planetary phenomenon. We inhabit a small rocky, wet planet, orbiting -- along with a handful of other planets -- an otherwise ordinary, undistinguished star, the Sun, in an otherwise obscure region of a galaxy, the Milky Way, containing more than 100 billion other stars, some larger than the Sun, some smaller, some older, some younger. The part of the universe we are able to see contains an estimated 100 billion other galaxies -- some larger, some smaller than ours -- some with more stars than our galaxy, some with fewer. The planet on which we live, Earth, formed, along with seven other surviving planets (and myriad smaller debris objects), around the Sun at the same time that the Sun formed, about 4 1/2 billion years ago, by which time our universe had already evolved through 2/3 of its current age. We call this system of the Sun, along with its associated planets and moons, and swarm of orbiting debris, the *Solar System*. So far as we know, the Solar System is not special in the Universe, and occupies no special position. But, in a real sense, the Solar System is the center of *our* universe, as good a center as any other place, and singularly important to us.

The best evidence indicates that life has been present on Earth throughout most of our planet's existence, probably having started between 3 1/2 and 4 billion years ago. During most of that time, terrestrial life consisted entirely of microbes. Only during the most recent billion years or so has multicellular life -- descended from colonies of those microbes -- become a prominent feature of our planet. Humans only recently developed out of those antecedents, and evolved to our current state gradually over the past several million years . . . a mere one-tenth of one percent of the age of Earth.

We live at an extraordinary time. After all the years of development, from single cells to

complex human beings, modern civilization, with mass agriculture and animal husbandry supporting vast technologically-based urbanization, emerged only over the past 10,000 years or so, and most impressively during the past 500 years. One of the singular features of this most recent era has been our development of reliably explanatory scientific understanding. This science gives us the unprecedented ability to learn about our planet, our solar system, and our universe (and eventually ourselves) in remarkable depth. And it has given us the ability to elucidate and understand the history and processes that produced us and shaped the terrestrial and cosmic environment on which our sustained existence depends.

This endeavor of understanding is made possible by the fact that our universe appears to be a cosmos, as that word was understood by early Greek philosophers:

> *Merriam-Webster Dictionary:*
> **COSMOS** 1. an orderly harmonious systematic universe -- cf. CHAOS

The apparent order, harmony, and systematic nature of our universe is reflected in the fact that it seems to be governed by regular, reliable laws, which, remarkably, are discoverable by human intelligence. Although we, by now, know a great deal, with high certitude, about our world, there is still a great deal that we do not yet know. The focus of this course -- to understand the Solar System (and the universe) -- is an ongoing endeavor.

This course is concerned mainly with the physical science aspects of our Solar System. We will learn about the physical constitution of the Solar System and its various objects, as well as how they came to be, and how and why they behave as they do. We will study how we learned what we know about the Solar System, starting with the era of telescopes, which has largely given way to the era of exploration. The current era of exploration, already stretches over nearly 60 years, as robotic spacecraft have explored Solar System objects up close, and *in situ*, even, in some cases returning samples to Earth for analysis in laboratories. We will study how and why the various planets in our Solar System differ, and the ways in which they are similar, including in terms of their current ability to support life. We will learn how studying other planets has helped us better understand Earth, including the possibilities -- and possible driving mechanisms -- of climate change. We will look past the current Solar System to learn what we know of its history and development, and how we know it. And we will look beyond our Solar System to see what we are learning about similar planetary systems around other stars.

Throughout the semester, we will emphasize how the basic physics of forces, motion, and the structure of matter work to shape and control our world, and help us to understand what we see. A full understanding of our own planet, Earth, ultimately requires an appreciation for the central role that life has played -- and still plays -- in shaping it. We will touch on that.

The primary conceptual aims of this course are: 1) to explore how science has revealed the nature of the Solar System -- the immediate environment of humans -- its history and cosmic context, and the processes that shape it; 2) to help you comprehend the essential underlying physics and see how the physical forces and the structure and behavior of matter shape the physical world; and 3) to help you gain an appreciation of how we know what we know, and why we are able to be confident in that knowledge.

Prerequisites

No special scientific or mathematical background beyond familiarity with typical high school physics, chemistry and algebra is assumed or needed for this course. Calculus will not be required, but we will engage rudimentary equations (algebra) and calculations. These will be designed to reinforce what you learn, and help strengthen your skills in applying quantitative reasoning. Examples relevant to the homework will be worked through in class.

One of the animating motives of this class is to help you learn how much you can understand on the basis of relatively simple ideas and concepts, without getting lost in a blizzard of details.

Learning Outcomes

The specific learning outcomes aimed at in this course focus on:

- Developing knowledge of basic scientific principles, and of how these principles are employed to advance and secure understanding of our world
- Advancing knowledge of the crucial roles played by observations, experiments and exploration in securing and understanding our world.
- Elucidating how the nature and behaviors of the world -- especially the Solar System -- are related to the underlying physical laws and properties of matter.
- Exploring the nature of light and how our understanding of the interactions of light and matter play such an important part in advancing our knowledge.
- Elucidating how we have been able to develop knowledge of the history and timescales of Solar System processes and events that produced -- and continue to sustain -- our world in its current state, and how we can apply that knowledge to under the phenomena of everyday experience and make certain informed projections about the future.
- Exercising skill in the rudimentary application of basic mathematics (arithmetic) to understanding our world.
- Developing an appreciation for the contingency and moving boundaries of knowledge, helping to define the difference between what we know with high certitude, and what we do not know, and why.

Course Textbook

The text for the course is:

> ***The Cosmic Perspective*** (8th or 7th edition is acceptable)
> by Bennett, Donahue, Schneider and Voit; Pearson (Addison-Wesley)

Generally speaking, the scope of this course pertains to Chapters 1-13 of the above book.

The above, full, version of the textbook also covers the material for ASTR-201 (Stars, Galaxies and the Universe). If you buy the book new and want the most up-to-date version, get the 8th edition. However, you will not be disadvantaged in this class by using the 7th edition.

Class Website

Course materials including problem sets, scores & grades, links to relevant websites, and supplementary material, as well as class updates and announcements will be

posted on, *or linkable from*, the Rice CANVAS webpage for ASTR 202 F17 [https://canvas.rice.edu/courses/7968], You are responsible for reading emails from the class website and checking the CANVAS course website regularly for up-to-date posted information.

Special Needs

Any student with a documented disability needing academic adjustments or accommodations should speak with the instructor during the first two weeks of class. All such discussions will be held confidential. Students with disabilities will need to contact Disability Support Services in the Ley Student Center: http://dss.rice.edu.

Adherence to Honor Code

The Rice Honor Code applies to all assignments in this class. All students should be familiar with Honor Code and Council rules and procedures, which can be found at http://honor.rice.edu. Be aware that, under Rice rules, the instructor has little discretion in reporting suspected violations, and is required to report such suspicions to the Honor Council for independent disposition. *See the next section for guidelines/rules pertaining to work submitted for this class.*

Homework &Tests

In addition to reading and study assignments from the text book, there will be regular homework, and occasional tests.

Homework: Weekly homework assignments with questions and problems based on material covered during the previous week (or weeks) in the textbook or in class lectures. Homework assignments will be posted on CANVAS each Tuesday, and due in class (or immediately before class if submitted online) the following Tuesday, unless otherwise specified in writing. For the homework, you may consult the textbook, your notes, and other materials, including the Web, unless otherwise indicated in writing. You may (and are encouraged to) discuss general concepts and approaches with your classmates before answering the questions, but the answers and work you submit must be entirely your own, based on your own understanding. Occasionally, for a homework question/problem, you may need to seek factual information available from the Web.

Tests: There will be two tests, one midterm test during the first half of October, following the midterm recess, and one end-term test during the last week of class; the end-term test will encompass class material from the second half of the semester, covered since the first test. For both tests you may consult both the text book and your own class notes. However, no other materials or sources, including web browsing, will be permitted: Each student is to complete the tests on her or his own, with no consultation. The tests will be similar to the homework in nature, except that each will cover a broader segment of the course, and be pledged under the Rice Honor Code as your own independent work. The tests will be "take-home" tests.

There will be no final exam.

Attendance and Participation

Students should plan to attend class regularly. Those who do not are likely to find themselves at a disadvantage, as, frequently, material will be covered in the lecture that is not be covered to similar depth in the book. Moreover, examples discussed or worked through in class are likely to be reflective of material in the homework or on tests. You are expected to be present and participate in class. Attendance will be taken (with a sign-in sheet passed around during each class period). Those with attendance rates above 90% (i.e. missing no more than 3 classes in the semester) will be awarded a 1/3 grade-step boost in the final grade.

Grades

Course grades will be based on the homework, the mid-term & end-term tests.

50%	Homework
25%	Mid-term test
25%	End-term test

The final assignment of letter grades may be adjusted on the basis of outcomes rather than based on a rigid, predefined scale. Every student who regularly and attentively attends class, and who diligently and attentively carries out the reading, study and homework assignments, should be able to achieve a fine grade in this class.

Machines in the Classroom

Cell phones must be turned off -- or rendered silent -- within the classroom. (If an unusual circumstance requires that you take an urgent call during the class, please try to take it out to the hallway.) Laptops or other small devices may be used only for specific class purposes such taking notes or in support of presentations. Other uses (browsing, email, etc.) are distracting and disruptive; if such use of machines should become a problem, all machine use will be banned during class time. (In any event, the nature of the course material is such that hand written-and-drawn notes are likely to prove far more useful than typed notes.)

Observing Sessions

The Rice University Campus Observatory (RUCO: www.ruf.rice.edu/~ruco/observatory.html) provides opportunity for hands-on observation of Solar System and other astronomical objects. Observing sessions will be scheduled during the semester. However, most Earth-based astronomical observing is subject to weather and local 'seeing' conditions. Observing sessions may be organized and cancelled at unavoidably short notice. The best nights for practical astronomy are clear and cold, so you are advised to dress warmly.

Issues

If you experience issues, difficulties, or misunderstandings that affect you in this class, you are strongly encouraged to speak directly with the professor as soon as you can.

Syllabus Subject to Possible Change

The information in this syllabus is subject to possible revision during the semester. If any changes are made, enrolled students will be notified in a timely manner.