Physics 15: Stars and Planets in a Habitable Universe

Summer 2026

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Open Door Hours: TBD

Course Logistics

Discussion Sections

TBD

Please enroll in the discussion section you are most likely to attend. Attendance at discussion sections is highly recommended, and will be required for the completion of some homework problems. These sections provide opportunities to ask questions, gather with classmates to work on problem sets or study for exams, and to work through new example problems with TAs.

Open Door Hours

Open door hours, or "office hours" are dedicated times set aside each week for you to stop by and ask any questions you may have about the course.

Course Description

How do stars form from the gas in galaxies? How do stars and galaxies evolve, and how can these processes give rise to planets and the conditions suitable for life? How do we, from our little corner of the cosmos, collect and decipher information about the Universe? This course covers the solar system and celestial motions, the life cycle of stars, the structure of our Milky Way galaxy, and the discovery of exoplanets: planets orbiting stars beyond our Sun. Intended to be accessible to non-science majors, material is explored quantitatively with problem sets using basic algebra and numerical estimates. Sky observing and observatory field trips supplement the course work.

Prerequisites
None. This course welcomes students from all majors and backgrounds. Quantitative reasoning, including interpreting graphical representations of data, is a key skill that we will develop and practice together. We will be using simple algebra and logarithms, make liberal use of scientific notation, and will practice making and interpreting plots. These skills are useful – even essential – far beyond astrophysics or scientific pursuits.

Units: 3 | Satisfies UG requirements DB-NatSci, WAY-SMA

Required Materials/Resources

- Textbook
  The Cosmic Perspective, 10th edition, by Bennett, Donahue, Schneider, & Voit
  - The text is available in the Stanford bookstore. You can purchase either electronic or hard-copies of the text, or you can rent the book through Amazon or through the publisher Pearson (this is the cheapest option we have found)
  - Copies of this textbook are available to borrow at the Stanford Science Library.
  - Note: Although we prefer you use the text edition above, you may also use other versions of this book, including:
    * Earlier editions of "The Cosmic Perspective"
    * A similar textbook called "The Essential Cosmic Perspective"
- Canvas
  Essential course information, including important announcements, additional reading, and links, will be posted on the course Canvas site.
- Poll Everywhere
  Some in-class activities will use Poll Everywhere (pollev.com/ftam). You can join these polls in a browser in your laptop or smartphone, or via the Poll Everywhere app.
- Gradescope
  Homework assignments and revisions will be submitted on Gradescope.

Note that the Tech Desk has equipment, such as iPads and Apple Pencils, that can be checked out for summer quarter if you are interested.

Learning Goals

After active engagement with this course throughout the quarter, you should be able to:

1. Create and interpret graphical representations of data, and use them for scientific inference.
    - Use scientific notation, and simple algebraic equations with exponents and logarithms.
    - Interpret plots with linear and/or logarithmic scales.
    - Make and evaluate order-of-magnitude quantitative physical estimates.
    - Convey explanations with visual representations (plots and graphs) and mathematical statements.
2. Describe the various techniques used to detect extrasolar planets, and explain how these methods are linked to selection biases.
3. Describe the celestial motions of the Sun-Earth-Moon system, and explain how these motions are observable from the Earth.
    - Diagram and explain the phases of the moon.
    - Explain why we experience seasons on the Earth.
4. Explain, at the level of a popular science article, how we use properties of light to measure information about the cosmos.
    - Describe and compare how different types of telescopes collect light.
    - Sketch an H-R diagram, and describe how the observed properties of stars are linked to their physical evolution.
5. Explain the structure and constituent parts of our Milky Way Galaxy at the level of a science article in a popular magazine or newspaper. This includes the distribution of stars, interstellar gas and dust, dark matter halo, and supermassive black hole.

Assessment and Grading

Grading will be based on:

Reading Quizzes	5%
PollEv Participation	10%
Homework Assignments	35%
Midterm	20%
Final	30%

Reading Quizzes

Reading Quizzes are short question sets on Canvas that are designed to give you and your teaching team rapid feedback about your current understanding of a topic, and to help you synthesize course content each week. You will be able to re-take each quiz as many times as you would like, and you will keep the highest score. (That means that you should be able to get 100% on every Reading Quiz.)

PollEv Participation

Class time will consist of lectures interspersed with small-group activities. To get the most out of this course, come prepared to actively participate in both, which will require answering a number of questions via Poll Everywhere. This portion of your final grade will be based on the total number of PollEv questions you answer. You must be in class to receive credit for each question, but you will only need to answer 80% of all the questions asked throughout the course to get full credit for this portion of your final grade – this is the *only* accommodation that will be provided for missing class time. I recommend that you plan to be in class on time for every class in case an unexpected emergency arises later in the quarter that requires missing a class.

Homework Assignments

This course will include weekly homework designed to help you deepen your understanding of the course content and to practice various skills.

Assignments will typically be distributed on Friday evenings and will be due the following Friday at 5 PM. All homework assignments will be submitted through Gradescope. Homework will include a combination of conceptual, quantitative, and short written essays, as well as exercises in graphing or interpreting data. Grading will be based on both correct answers and clear explanations of your thinking process. You are encouraged to work on the homework problems yourself first, but then also in groups – discussing concepts with your peers facilitates learning and retention of material. However, limit your collaborations to discussions about understanding the underlying principles, not specific solutions. Avoid duplicating answers to abide by Stanford's Honor Code.

Turn in drafts of your assignments early and plan to turn in the final version to Gradescope on time! **Late homework will not be accepted for any reason, including technical issues with uploading**, as solutions will be published immediately following the deadline. Only the most recent version submitted before the deadline will be graded, so turn in drafts to ensure that you get as much credit as possible if you run into technical difficulties right before the deadline. If on any given week, you don't have time to finish your homework, be sure to turn in what you have completed by the deadline.

Although late homework will not be accepted, you may turn in homework revisions, that will be worth up to 50% of the points missed, including questions not attempted on the first go around. Homework revisions will typically be due the Tuesday immediately following the original homework due date at 5 PM. Homework revisions are encouraged as a learning tool that will help you correct misunderstandings and practice for exams. Note that your original homework submission will not be graded prior to the revision due date. For your revisions, compare your homework with submission to the published solutions and identify whether or not your answers might have been incorrect or insufficient. Then, to receive credit for each revised answer, you must

1. explain in writing why you think your original answer may lose points;
2. explain in writing where the deficiency was in your original process and what you will do to avoid repeating the error moving forward; and
3. explain, in detail, how to arrive at the correct solution.

You will only need to get 80% of the available homework points for the quarter to receive full credit for this portion of your final grade.

Exams

There will be an in-class closed-book midterm exam on Tuesday, July 22. The closed-book final exam will be held during the final exam period on Saturday, August 16 from 8:30 - 11:30 am. **There will be no make-up or remote exams.** If you are sick or unable to take the midterm exam, you must email the teaching team no later than an hour before the start of the exam to let us know. In such cases, your grade on your final exam will count towards both midterm and final portions of your grade. **You must take the final exam to pass the class.** If you cannot take the final for any reason, then you should you will need to request for Incomplete in the course by contacting the teaching team. After you receive your graded midterm back with the solutions, you will have the opportunity to submit midterm revisions for up to 20% of the points missed on the midterm. There will be no final revisions.

Final Grades

Your final grade will be calculated based on the elements described above. Your grades will never be curved down. If you receive grater than or equal to the following percentage points, you will get at least the following grade:

97	A+	87	B+	77	C+	67	D+
93	A	93	B	73	C	63	D
90	A-	80	B-	70	C-	60	D-

Course Expectations

How much time should this course take?

This is a 3-credit course, so you should expect to spend approximately 9 hours per week of dedicated, focused time working on the course (including time spent attending class). If you find yourself spending substantially more time on the material each week, please let the teaching team know. Effective time management while working or studying is a skill that can be improved: if you find yourself putting in long hours but struggling to spend that time productively, you may benefit from reaching out to the Summer Academic Resource Center (SRC).

Course Communication

Please follow these guidelines regarding communication with the teaching team:

- If you have questions about the course material, ask it during lecture or go to a discussion section or open door hours.
- If you have questions about the course logistics, post your question as a discussion topic on Canvas. It's very likely that another student has the same question, so this allows us to answer it once.
- If you have a private question, email the instructor directly at ftam@stanford.edu

Collaboration Policy

Science is collaborative: you are free and encouraged to work together with your peers on homework problems, but you must turn in your own individual work, in your own words. Participation in this course means that you have read and agree to abide by the Honor Code (see below).

Honor Code

The Honor Code articulates University expectations of students and faculty in establishing and maintaining the highest standards in academic work. Examples of conduct that have been regarded as being in violation of the Honor Code (and are most relevant for this course) include copying from another's homework or examination paper or allowing another to copy from one's own paper; unpermitted collaboration; plagiarism; representing as one's own work the work of another; and giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted. See the Office of Community Standards for more information on the Honor Code. Unpermitted collaboration and plagiarism includes copying solutions from solution manuals – hardcopy or online (including output from AI tools) – and representing it as one's own work. The best way to learn the material and to prepare for the midterms and final exams is to work through the problems on your own or with classmates, without consulting solutions that someone else has written up. As stated above, in this course we encourage students to discuss issues and problem-solving strategies related to the assigned homework problems. However, the solutions to the problems must be written up independently unless explicitly designated as group work.

Classroom Climate

Our time together will be spent on both lectures and small-group activities, and I expect all of us to participate actively in both. My most important expectation is that everyone contributes to a supportive, intellectually curious learning atmosphere. This means engaging with in-class discussions and asking questions; this also means speaking to one another respectfully.

Fear of asking questions can be an impediment to learning. In small-group exercises, the most valuable contributions to learning can be questions like "I don't understand why we can come to that conclusion... can we discuss it further?" or "How did that step work... can we go over it again?" or "I don't recall seeing that terminology / symbol / notation before... can we review the precise definition?" Everyone in your group will benefit from an atmosphere that encourages these and all questions. Our understanding of concepts can be quite muddled until we attempt to articulate them verbally or in writing. If you ask a question and receive a response from a classmate that doesn't bring complete clarity, try responding with "Is this what you are saying?" and then describe your interpretation of the explanation in your own words. Everyone at your table can listen and give input to bring further clarity.

To facilitate the most effective and inclusive learning environment by promoting deliberate exploration of what we don't know, we have two "social rules":

1. Please resist acting surprised when people say they don't know something. Feigning surprise does not have social or educational benefit.

2. Avoid subtle racism, sexism, homophobia, transphobia, and other kinds of bias. "Subtle-isms" are small things that make others feel uncomfortable. For example, saying "It's so easy my grandmother could do it" is a subtle-ism.

If you find yourself breaking one of these rules, please apologize, use it as a learning experience, and then move on. If you see repeated feigned surprise, or hear a subtle-ism, you can point it out to the relevant person, either publicly or privately, or you can ask a member of the teaching team to say something. After this, we ask that further discussion move off public channels. The "subtle" in "subtle-isms" means that it may not be immediately obvious to everyone what was wrong with the comment. Please use it as a teachable moment, and then assume the message was received.

Equity and Inclusion in the Classroom and Beyond

In addition to expecting students and faculty to establish and maintain the highest standards in academic work in accordance with the honor code, the Physics Department further expects all members of the community to engage with one another respectfully and openly. Creating and maintaining an equitable and inclusive community requires consciousness of action from all physics community members. Everyone, from undergraduate students taking a single physics class, to physics majors and graduate students, to faculty, staff, and postdocs, contributes to the culture and climate of the department through their actions. As such, we expect respect for all members of the community, regardless of race, ethnicity, age, color, disability, faith, national origin, immigration status, gender identity, gender expression, sexual orientation, social class, and all other identities represented in our community. Visit physics.stanford.edu/about/equity-and-inclusion to learn about the Physics Department's Equity and Inclusion Committee and their commitment to our community. They welcome you to reach out to them with any questions, comments, or concerns!

Course Support

Access and Accommodations

Stanford is committed to providing equal educational opportunities for disabled students. Disabled students are a valued and essential part of the Stanford community. We welcome you to our class.

If you experience disability, please register with the Office of Accessible Education (OAE). Professional staff will evaluate your needs, support appropriate and reasonable accommodations, and prepare an Academic Accommodation Letter for faculty. To get started, or to re-initiate services, please visit oae.stanford.edu.

If you already have an Academic Accommodation Letter, we invite you to share your letter with us. Academic Accommodation Letters should be shared at the earliest possible opportunity so we may partner with you and OAE to identify any barriers to access and inclusion that might be encountered in your experience of this course.

Student Learning Support

The Summer Academic Resource Center (SARC) offers free academic support services including tutoring and academic advising to visiting and matriculated Stanford students enrolled in the University's summer quarter. SARC is located in Harmony House, but we also offer some 1:1 tutoring over Zoom. Students enrolled in courses are automatically enrolled in the SARC Canvas site, where they can find the schedule for drop-in tutoring and workshops.

Course Schedule

The schedule is tentative and subject to change; the schedule posted on Canvas will remain up-to-date. We will schedule both an observing night at the Student Observatory and a daytime tour of the Wilcox Solar Observatory. These events will be optional, but highly encouraged.

Week	Lectures	Reading
1 6/22-26	**Welcome to Physics 15!**	Syllabus
	Lecture 1: The scale of the universe in space and time	Chapter 1
	Lecture 2: The night sky and our place in the universe	Chapter 2
2 6/29 - 7/2	Lecture 3: Planetary motion & the science of astronomy	Chapter 3
	Lecture 4: Motion and conservation laws	Chapter 4
3 7/6-10	Lecture 5: Light & Matter	Chapter 5
	Lecture 6: Telescopes	Chapter 6
4 7/13-17	Lecture 7: Solar system structure & formation	Chapters 7, 8
	Lecture 8: Terrestrial Planets and Planetary Atmospheres	Chapters 9, 10
5 7/20-24	Lecture 9: Giant & Dwarf Planets	Chapters 11, 12
	In-class MIDTERM Exam: July 22nd	
6 7/27 - 7/31	Lecture 10: Exoplanets!	Chapter 13
	Lecture 11: The Sun and an intro to stars	Chapter 14
7 8/3-7	Lecture 12: Stellar properties and the HR diagram	Chapter 15
	Lecture 13: Star Formation	Chapter 16
8 8/10-14	Lecture 14: Stellar Lives and Remnants	Chapters 17, 18
	Lecture 15: Life in the Universe	Chapter 24
	FINAL Exam: TBD	