

ASTR/PHSC 12720: Exoplanets - Spring 2021

Basic Information

Instructor: Prof. Leslie Rogers (larogers@uchicago.edu, pronouns: she/her)

Classes: T/Th 9:40 – 11:00 CDT, Remotely on Zoom

[Lecture Zoom link](#)

Synchronous attendance at lectures strongly encouraged

Lectures will be recorded and posted to Canvas

Labs: Once per week, starting 2nd week

Lab Manager: Brent Barker (bbarker@uchicago.edu, pronouns: they/them)

Academic Affairs Admin: Julia Borst Brazas (julia@uchicago.edu, pronouns: she/her)

Teaching Assistants

Andrea Bryant (asbryant@uchicago.edu, pronouns: she/her)

Adina Feinstein (afeinstein@uchicago.edu, pronouns: she/her)

Jazmine Jefferson (jjefferson1111@uchicago.edu, pronouns: she/they)

Andrew Neil (aneil@uchicago.edu, he/him)

Sam Usman (samanthausman@astro.uchicago.edu, pronouns: she/her)

Office Hours

I will hold office hours on Mondays 4-5pm on Zoom ([Prof. Rogers Office Hours Zoom Link](#)). Students are always welcome to contact me to set up an appointment to meet outside of these regular hours. I am invested in everyone being successful in this class!

This term we will be using Ed for online class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TAs, and myself. Rather than emailing questions to the teaching staff, I encourage you to **post your questions on the Ed Discussion** forum (accessible through Canvas).

Textbook

“How do you find an Exoplanet” by John Asher Johnson, ISBN 9781400873999

Available for free online through the UChicago Library:

<http://pi.lib.uchicago.edu/1001/cat/bib/11452153>

Supplemental Readings will be posted to Canvas.

Learning Objectives

- To gain an understanding of the intellectual beauty of astronomy in general and exoplanets in particular, that is, to gain an understanding why some people devote their life to the field;
- To learn fundamental facts about exoplanets and how we know these things;
- To gain practice applying math and physics to learn about the physical world;
- To instill the confidence to be a life-long learner in areas involving numbers, scientific concepts, and technology;
- To develop an ability to evaluate the strengths and weaknesses of arguments based on the use of data, technical claims, and scientific theories encountered in the media.

Course Description

The past two decades have witnessed the discovery of planets in orbit around other stars and the characterization of extra-Solar (exo-) planetary systems. We are now able to place our Solar System into the context of other worlds and a surprising conclusion that most planetary systems look nothing like our own. A challenging next step is to find planets as small as the Earth in orbit around stars like the Sun. The architecture of planetary systems reflects the formation of the parent star and its protoplanetary disk, and how these have changed with time. This course will review the techniques for discovery of planets around other stars, what we have learned so far about exoplanetary systems, and the driving questions for the future, including the quest for habitable environments elsewhere. Although quantitative analysis will be an important part of the course, students will not be expected to employ mathematics beyond algebra.

Prerequisite/Degree Requirements

In order to satisfy the general education physical sciences requirement, PHSC 10800, PHSC 10100, PHSC 12700 or PHSC 12710 must be taken before PHSC 12720 to form an approved sequence. If PHSC 12720 is to be taken as an elective, the prerequisite is recommended but not required.

Approved PHSC sequences: PHSC 12700-12720, PHSC 12710-12720, PHSC 10800-12720 or PHSC 10100-12720.

This class can also be used for the Astronomy minor.

This class should ideally not be taken in conjunction with ASTR 18000.

Course Components:

Post-Lecture Quizzes	15%
Online Ed Discussion Forum Assignments	15%
Labs	35%
Final Project	35%

Students are expected to **complete the assigned reading(s) prior to each lecture**. In-class sessions are designed to help students engage with, assimilate ideas from, and deepen their understanding of material they were already exposed to in the readings. A portion of every class will be devoted to active learning, where students will work through homework-like quantitative problems and concept-test questions in small groups and with instructor guidance. **Synchronous participation in lecture sessions is strongly encouraged.**

There will be **short low-stakes quizzes** that are due after each lecture. Students should complete the quiz within 1 week of the lecture. Each quiz will encompass both the material uncovered during the lecture, and the material from the required reading(s) associated with the lecture. The quizzes are on Canvas. The lowest 2 quiz scores will be dropped. Students should complete all quizzes on their own, with no communication with anyone else except the instructor or TAs.

There will be **four labs** that are run by the Lab Instructor and TAs. The outcome of the labs will be lab reports that submitted to the TAs through Canvas. (See the Lab Syllabus for more details).

Students also receive credit for **participating in the online Ed Discussion forums**. To earn a perfect grade for participating in the Ed Discussion Forums, students should make at least **one thoughtful post per lecture** relating to the class's content, submitted within 1 week of the lecture (missing no more than 2 lectures). Examples of "thoughtful posts" include asking a substantive question, answering another student's question, correcting/expanding upon a previous answer, commenting on a posted article, posting a news article, and responding to an instructor's prompt. The Ed Discussion Forum is accessible through Canvas.

Instead of a final exam, students will complete a **final project**. For this project, students are expected to synthesize a key idea or research problem related to the course subject (rubric provided). The final project must be the student's individual work and should be a new creation (not previously submitted for credit to another class). Final projects are due Wednesday, June 2nd at 11:59pm.

Quality **grades** will be assigned post-facto based on the cumulative score. Regardless of the class performance, a 90% cumulative score guarantees an A-, 80% a B-, 70% a C-, and 65% a D. The grades will only be curved up, if at all, and never down.

Late Policy

Late labs, quizzes, Ed discussion posts, and final projects will incur a 10% penalty per calendar day, up to a maximum penalty of 50%.

To request an extension, submit [this form](#).

The last moment to turn in any lab reports is the day before Reading Period, Friday, May 28th at 11:59pm. The last moment to submit any outstanding quizzes and Ed discussion posts is June 2nd at 11:59pm. The last moment to turn in final projects is June 2nd at 11:59pm for graduating seniors, and Friday June 4th at 11:59pm for non-graduating students. We will not generally be able to accommodate extension requests past these hard cutoffs, due to the Registrar's spring quarter grade deadlines.

Expectations of Student Behavior:

- **Abide by the honor code** and follow UChicago policies [on academic integrity and student conduct](#).
 - Students must complete all quizzes on their own, with no communication with anyone else except the instructor or TAs.
 - Group work is encouraged for the labs. Each lab-group can submit a single group report. You are expected to collaborate fully with your group mates, and the report must describe the contributions of each member of the group. You should not collaborate on the report with students outside your lab group. You may not use data that you didn't take yourself or with your group.
 - A student's final project must be their own individual work and should be a new creation (not previously submitted for credit to another class). Ideas/text/media from others must be appropriately cited.
- **Be respectful** by actively listening, seeking to understand comments, and critiquing ideas (not people).
- **Be engaged** by sharing your knowledge, coming prepared, and cooperatively working with your colleagues.
- **Exercise intellectual curiosity and humility** by asking questions, taking risks, and acknowledging times when you do not know an answer.

Zoom Classroom Norms:

- This class aims to nurture a supportive, collaborative learning environment (where mistakes are encouraged and expected). Please behave in a supportive, collaborative, and respectful way toward your classmates. Respect individual differences in values, personalities, work styles, and theoretical perspectives.
- Engage in constructive group behaviors (cooperating, clarifying, inspiring, harmonizing, risk taking, process checking) and try to avoid destructive group behaviors (dominating, rushing, withdrawing, discounting, digressing, blocking).
- Please keep yourself muted in Zoom when you're not speaking.
- Please use the "raise hand" feature in zoom or type a question in the chat to ask a question/make a comment during class presentations and full-group discussions.
- Small group discussions in break-out rooms may not require use of the "raise hand" feature to indicate that you want to speak. Regardless, please be aware of how much/how little space you are occupying in the discussion. Each individual in a breakout room shares the responsibility to tend to the wellbeing of the discussion.
- There is an expectation that students in this course will be actively engaged and on camera (when possible) while on Zoom, especially during breakout discussions. I am mindful that it is not always possible or convenient to turn on one's camera/microphone, so students are also welcome to participate through the chat feature and/or without video, when necessary.
- Synchronous participation in lectures is strongly encouraged. I aim to make the lecture sessions interactive, with in class concept-test poll questions, think-pair-share activities, and interactive discussions. You will lose out on the in-class activities and overall learning experience if you don't attend the lectures synchronously. Class sessions will be recorded and posted on Canvas, for students who must miss a given lecture.

Recording and Deletion Policies for Academic Year 2020-2021

The Recording and Deletion Policies for the current academic year can be found in the Student Manual under [Petitions, Audio & Video Recording on Campus](#).

- Do not record, share, or disseminate any course sessions, videos, transcripts, audio, or chats.
- Do not share links for the course to those not currently enrolled.
- Any Zoom cloud recordings will be automatically deleted 90 days after the completion of the recording.

Appreciation for Diversity

The University of Chicago believes that a culture of rigorous inquiry demands an environment where diverse perspectives, experiences, individuals, and ideas inform intellectual exchange and engagement. I concur with this commitment and also believe that we have the highest quality interactions and can creatively solve more problems when we recognize and share our diversity. I thus expect to maintain a productive learning environment based on open communication, mutual respect, and non-discrimination. I view the diversity that students bring to this class as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity. Any suggestions for promoting a positive and open environment will be appreciated and given serious consideration.

Students with Disabilities

I recognize that students in this class include people with a wide range of visible and invisible disabilities—cognitive, learning, emotional, psychological, and physical, and I welcome all students of various backgrounds and abilities. If there are circumstances that make our learning environment and activities difficult, please contact Student Disability Services at 773.702.6000, or disabilities@uchicago.edu to explore reasonable accommodations.

Students in Need

Graduate students facing challenges securing food or housing who believe this may affect their performance in the course are urged to contact [Student Support Services](#) at 773.702.5710 for support. Students in the College may contact the [Center for College Student Success](#) at 773.702.1234.

PHSC 12720: Exoplanets
Spring 2021
Lecture Schedule and Reading List

Note: The reading list and class schedule may be revised as the quarter proceeds.

Week 1, T Introduction: What is a Planet? What is an Exoplanet?

Reading: Course Syllabus
Salyk & Lewis (2020) Chapter 1

Week 1, Th Solar System Overview

Reading: Bennett et al. Chapter 7 (pp. 190-211)

Week 2, T Why do planets move as they do?

Reading: Johnson Chapter 1 (pp 1-22)

Week 2, Th Techniques: radial velocity

Reading: Johnson Chapter 2 (pp 23-58)

Week 3, T Telescopes

Reading: Bennett et al. Chapter 6 (pp. 165-185)

Week 3, Th Techniques: transits

Reading: Johnson Chapter 3 (pp. 59-89)

Week 4, T Techniques: transits (continued)

Reading: None

Week 4, Th Techniques: direct imaging

Reading: Johnson Chapter 5 (pp. 114–130)

Week 5, T Techniques: direct imaging (continued)

Reading: Salyk & Lewis (2020) Chapter 2

Week 5, Th Techniques: microlensing, astrometry, and timing

Reading: Johnson Chapter 4 (pp. 90-109)

Week 6, T Techniques (Continued) + Mid-Quarter Review

Reading: Salyk & Lewis (2020) Chapter 5

- Week 6, Th Statistical distributions of exoplanets**
Reading: Winn (2018) *Handbook of Exoplanets*
- Week 7, T Planet formation**
Reading: Watch videos from the MOJO project (parts 1, 2, and 3)
Part 1: <https://www.youtube.com/watch?v=4Cs6qUHz3yA>
Part 2: <https://www.youtube.com/watch?v=dtwyb6eQJ9Q>
Part 3: <https://www.youtube.com/watch?v=QYTMZFgGdPg>
(Optional): Salyk & Lewis (2020) Chapter 9
- Week 7, Th Planetary structure and composition**
Reading: Dave Stevenson Lecture Notes, Chapter 2
- Week 8, T Exoplanet atmosphere observations**
Reading: Salyk & Lewis (2020) Chapter 8
(Optional): Kreidberg (2018) *Handbook of Exoplanets* Ch. 102
(Optional): Biller & Bonnefoy (2018) *Handbook of Exoplanets* Ch. 103
- Week 8, Th Planet Habitability**
Reading: Meadows & Barnes (2018) *Handbook of Exoplanets* Ch. 129
- Week 9, T Life and biosignatures**
Reading: Seager & Bains (2015) *Sci. Adv.* **1**, pp. 1-11
(Optional): Kite, E. and Howard, A (2013) *Physics Today*, **66**, pp. 8-9
- Week 9, Th Final Review – Exoplanet Escape Room**
Reading: Astrobiology: A history of exobiology and astrobiology at NASA (graphic history), Living Beyond the Solar System, NASA, Issue 6:1-42.