

ASTR 0001: A Survey of the Universe

Spring 2023 | Sec 02

with [Prof. Mathew Madhavacheril](#)

Mondays and Wednesdays 12:00-1:29pm

Lecture hall A6 in David Rittenhouse Laboratory (DRL; 33rd and Walnut St.)

Office hours: Tuesdays and Fridays 3-4pm,
DRL 4N39

[How to get to my office](#)

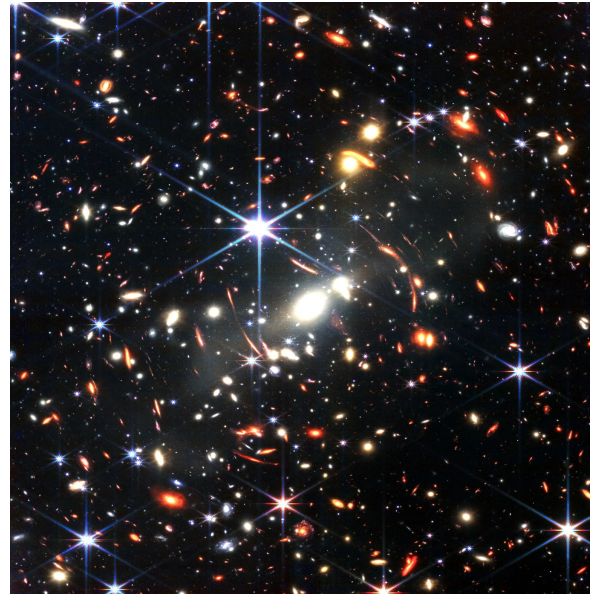


Image: A small region of the sky observed by the James Webb Space Telescope in mid-2022. Most of the objects are distant galaxies each containing hundreds of billions of stars.

IMPORTANT: Only one ASTR course below ASTR211 (this includes ASTR001, ASTR003, ASTR006, and ASTR007) may be taken for credit. Engineering students receive no credit for this course.

SYLLABUS

This course is an introduction to astronomy for non-majors. We will survey theories and observations of the astronomical universe, from our own solar system, to stars, galaxies and the study of cosmology, i.e. the birth and evolution of the Universe as a whole.

The Earth is big, the Solar System is a lot bigger, the galaxy is immensely bigger, and even just the *observable* universe is unfathomably bigger. We will build perspective for the vastness of the cosmos. We will develop quantitative skills towards describing and understanding the processes in it, starting near home: understanding seasons and the phases and eclipses of the moon, all the way to describing mysterious components of the Universe like Dark Matter and Dark Energy.

Importantly, a broad goal of this course is for you to be able to go beyond just facts and stories, but push to a deeper understanding of the scientific underpinnings of astronomy. We will often ask “**how do we know what we know?**”, and we will often remind ourselves how the scientific framework around modern astronomy allows us to not just make predictions but also allows us

to *falsify* our theories. Yet another theme we explore is how simple fundamental physics notions allow us to have elegant descriptions of the various processes in the Universe.

Prerequisites and credits: Elementary algebra and geometry will be used. This course is not recommended for physical-science majors or engineering students. Engineering students receive no credit for this course. This course fulfills the quantitative data analysis requirement.

Attendance: We will have lectures in-person. In-person attendance is critical: while a little more than half of each class will involve a lecture, the remaining in-class time will be dedicated to interactive sessions, demonstrations as well as problem solving walk-throughs. **There will also be graded lab sessions where you will perform astronomical measurements from the DRL rooftop observatory.**

Accommodations

It's important to me that everyone who wants to participate has the [resources](#) to be fully included in this course. Please let me know if you need special accommodations in the curriculum, instruction or assessments of this course to enable you to participate fully. I will make every effort to maintain the confidentiality of the information you share with me.

Penn provides reasonable accommodations to students with disabilities who have self-identified and been approved by [Student Disabilities Services](#) (SDS). If you have not yet contacted SDS and would like to request accommodations or have questions, you can make an appointment by calling SDS at 215-573-9235. The office is located in the [Weingarten Learning Resources Center](#) at Stouffer Commons: 3702 Spruce Street, Suite 300. All services are confidential.

Week 1

- **A New Perspective through Astronomy**

Week 2

- **The Universe You See and Experience**

Week 3

- **Astronomy as a Science**
- **Homework 1 Due**

Week 4

- **Motion, Energy and Gravity**
- **Light and Matter**

- **Homework 2 Due**

Week 5

- **Extending Human Capability with Telescopes**
- **Our Solar System and its Formation**
- **Homework 3 Due**

Week 6

- **Mid-Term 1**
- **Planetary Geology and Atmospheres**

Week 7

- **Homework 4 Due**
- **Jovian Planets**
- **Asteroids, Comets and Dwarf Planets**

Week 8

- **Homework 5 Due**
- **Exoplanets**

Week 9

- **The Sun**
- **Surveying the Stars**
- **Homework 6 Due**

Week 10

- **Star Birth**
- **The Life Cycle of a Star**
- **Mid-Term 2**

Week 11

- **Stellar Graveyards**
- **Bonus Material | Relativity, Time Travel and Gravitational Waves**

Week 12

- **Homework 7 Due**
- **Our Galaxy**

Week 13

- **The Extra-Galactic Universe**
- **Galaxy Evolution**

Week 14

- **The Big Bang**
- **Homework 8 Due**
- **The Dark Universe**

Week 15

- **Life in the Universe**
- **Bonus Material | The Multiverse**
- **Homework 9 Due**

Week 16-17: Final Examination

Materials

Required: [Mastering Astronomy](#) web access

Once you have paid or requested temporary access, click on "MyLab and Mastering" on the left panel on Canvas to finish setting it up.

Recommended: [Cosmic Perspective, 9th Ed. Bennett, Donahue, Schneider, Voit](#)

Readings will be assigned; you are expected to come to class having read the assigned material.

After each lecture, slides will be made available on Canvas.

Evaluation

There will be **1 homework assignment roughly every week, an astronomy lab, two mid-terms and a final:**

1. Mid-Term 1 will be on Feb 15 (drop deadline is Feb 20)
2. Mid-Term 2 will be on Mar 22 (withdraw deadline on Mar 27)
3. Final examination date is TBD, but some day May 1-9
4. The astronomy lab can be scheduled throughout the semester through Canvas with our lab instructor Simon Dicker

- **Homeworks will count toward** 30% of the grade
- **Your *best* mid-term will count to** 30% of the grade

- The astronomical observation lab will count towards 10% of the grade
- The final will count to 30% of the grade

Homeworks will be administered online and instantly graded through [Mastering Astronomy](#), which is a required material for this course.

Each mid-term is scheduled a few days before the Drop and Withdraw deadlines, respectively. Grades should be available well before those deadlines. Only the mid-term in which you scored highest will count towards the final grade. Grades will be curved.

Tips for performing well

- **Come to class.** The textbook covers a lot of material. What I cover in class is what will be tested in the exams.
- **Submit all your work;** don't miss a homework assignment. Students near grade boundaries may be bumped up at the end of the semester, but only if they submitted all homeworks, lab material and attended all three exams.

Communication

Join the Discord server. ([Link on Canvas](#)) This server can be used primarily for text and voice communication with your classmates.

- **From me to you:** check for announcements on Canvas, email, and Discord at least once between classes. I will also make announcements at the start of class.
- **From you to me:** [use the Canvas Inbox to contact me](#). Don't count on my replying quickly to messages: expect a response **within 2 business days** (i.e. not on weekends). You will have better luck on the Discord server for homework help and lecture questions, which I will check at least once a day.
- **From you to you:** you will also be able to answer each other's questions using Discord. I expect you to follow the guidelines provided in the syllabus to keep our online discourse inclusive of and useful for everyone.
- **Office hours:** Tuesdays and Fridays 3-4pm, DRL 4N39. See [how to get to my office](#).

COVID Precautions

In order to keep everyone as safe as we can, please respect the following [precautions](#):

- **Get vaccinated.** This is required by Penn for all students, faculty, and staff, with few exceptions.

- **If you feel sick or were exposed to COVID, get a test:** The University offers on-campus Covid testing to all students on demand and at no cost regardless of vaccination status. To schedule a voluntary Covid test, please go to [this website](#) and click on the “Schedule a Test” link. The SAS Dean's office strongly encourages all students to take advantage of this free service at any time, especially if you are feeling ill or believe that you have been exposed to someone who has Covid. Alternatively, take a home rapid test.
 - **If you test positive for COVID, please do not come to class or office hours.** Specifically, please participate remotely for [5 days after a positive COVID test](#). Let me know you'll miss class by filing a [Course Absence Report](#) through [Penn InTouch](#), keep up with the material online, and follow up with me to make up assignments as needed. **Your grade in this class will not be penalized for precautions to protect each other from COVID.**
 - **You can rest assured that I will follow similar precautions if I feel sick or were exposed to COVID or test positive for COVID. It is likely that the class will be held remotely on Zoom if this happens.**
 - **You are invited to [wear a mask](#) in class if you:**
 - want to for any reason
 - are immunocompromised and personally at high risk
 - are in frequent close contact with someone who is high risk
 - tested positive for COVID-19 more than 5 but less than 10 days ago (if less than 5 days, please participate remotely)
 - have been exposed to someone with COVID-19
 - have recently traveled to an area with substantial or high spread of the virus
- Please respect the choices of your classmates. If you feel targeted or uncomfortable in class, speak with me.**

Academic Integrity

Participants are expected to abide by the [Penn Code of Academic Integrity](#) in letter *and* spirit. Scientific research is a collaborative endeavor that depends on proper acknowledgment of each person's contributions to a project: this holds in this course as it does in general.

Cheating and violations of academic integrity may be reported by the instructor for further disciplinary action. The following in particular should be noted: you may discuss homework questions with others in broad, general terms, but the work you submit should be your own. Giving homework answers to another person or taking them from another person counts as cheating. The homework is meant as practice for the exams, so if you take answers from others, you are not only violating the code of academic integrity, but also making it likely that you will perform poorly in the exams. This doesn't mean you can't work together; you could, for example, solve the problems together at a blackboard, and then go back and re-do the homework individually without copying from the blackboard.

“Creating a supportive environment to enable scientific discourse
... is the responsibility of all participants.”

American Physical Society,
Code of Conduct for APS Meetings

Fostering an inclusive atmosphere in scientific discussions is an integral part of academic and professional ethics. Participants are expected to abide by the [Penn Code of Student Conduct](#) during course activities, and to use the following guidelines as a standard of behavior¹:

Expected Behavior

- Be considerate, respectful, and collaborative.
- Critique ideas rather than individuals.
- Avoid personal attacks directed toward other participants.
- Be mindful of your surroundings and of your fellow participants.
- Respect the rules and policies of our online classroom in [Canvas](#), Discord, and [Zoom](#).

Unacceptable Behavior

- Harassment, intimidation or discrimination in any form will not be tolerated.
- Physical, verbal, or online abuse of any participant will not be tolerated.
- Examples of unacceptable behavior include, but are not limited to: verbal or online comments related to gender, gender identity and expression, sexual orientation, disability, physical appearance, body size, race, religion, national origin, as well as inappropriate use of nudity and/or sexual images, and threatening or stalking any participant.
- Recording or photographing another individual without their explicit permission is not allowed.

Consequences

- Anyone requested to stop unacceptable behavior is expected to comply immediately.
- The course instructor may take any action deemed necessary and appropriate, including immediate removal from a class session or the course, or referral to university disciplinary procedures.

Reporting Unacceptable Behavior

- If you are the subject of unacceptable behavior or have witnessed any such behavior, please immediately notify the instructor.
- Anyone experiencing or witnessing behavior that constitutes an immediate or serious threat to public safety should contact campus security at **215.573.3333**.

Any member of the Penn community can call the Penn HELP line² at any time
to be connected with staff trained for mental health referrals:

215-898-HELP(4357)

¹ Adapted from the [Ecological Society of America meeting code of conduct](#).

² <https://www.publicsafety.upenn.edu/safety-initiatives/help-line-215-898-help/>