



This is one slice through the map of the large-scale structure of the Universe from the Sloan Digital Sky Survey and its Baryon Oscillation Spectroscopic Survey. Each dot in this picture indicates the position of a galaxy 6 billion years into the past. The image covers about 1/20th of the sky, a slice of the Universe 6 billion light-years wide, 4.5 billion light-years high, and 500 million light-years thick. Color indicates distance from Earth, ranging from yellow on the near side of the slice to purple on the far side. Galaxies are highly clustered, revealing superclusters and voids whose presence is seeded in the first fraction of a second after the Big Bang. This image contains 48,741 galaxies, about 3% of the full survey dataset. Grey patches are small regions without survey data. *Image credit:* Daniel Eisenstein and the SDSS-III collaboration.

Syllabus for Astronomy 0001: *Survey of the Universe*, Fall 2023

Course meetings: TR 10:15-11:44 am in [DRL A6](#) (Section 2) [building access](#)

Instructor: [Prof. Robyn Sanderson](#) - **Office:** DRL 4N10

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.

Welcome to *Survey of the Universe*! I look forward to sharing my favorite subject with you this semester. You may find some material challenging, but I hope you will also be inspired and amazed by what you learn.

By the end of the course, you will be able to:

- A. Use proportionality in simple algebraic expressions
- B. Deal with very small and very large numbers using logarithmic scales, orders-of-magnitude reasoning, exponential notation, and unit conversion
- C. Assess whether an investigation follows scientific principles
- D. Interpret astronomical images, spectra, and 2D scatter plots
- E. Relate the scales of different structures in the universe to one another
- F. Combine and draw conclusions from different sources of information about the universe
- G. Understand which basic physical principles govern different astronomical phenomena
- H. Catalog the fundamental types of matter and energy in the universe and their properties
- I. Tell the story of the universe from its birth to the present day
- J. Trace the production and assembly of the ingredients for life on Earth
- K. Explain to your friends & family why *you* think astronomy is cool

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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.

You will need:

A **computer** that:

- Has an internet connection fast enough to stream or download the video lectures
- Has a secure [web browser that is supported by Canvas](#)
- Satisfies the [system requirements for Canvas](#)

Some way to **submit your work electronically**:

- If you don't want to type all your assignments, you can use a **smartphone camera** to scan/photograph handwritten work, either [using built-in apps](#) or [using a free third-party scanner app](#) ([broader list including paid and free options](#)). You don't need Optical Character Recognition (OCR; converts handwriting into typed text). See these [guidelines for making a legible photo](#).
- At libraries and copy centers, **copy machines will often also scan documents** and email them to you as a PDF, which you can then submit.
- Or you can **type everything on a word processor** - [Microsoft Word now allows you to typeset equations in LaTeX](#), and [so does LibreOffice](#) (an [open source alternative](#) to Microsoft Office)

You may also want:

[Bennett, Donahue, Schneider, & Voit, *The Cosmic Perspective*](#) (the course textbook)

We follow approximately the order and contents of this book, which offers alternative explanations of the concepts covered in the course. However, **you will be responsible for learning only material covered in the lectures**, so you are **not required to purchase** it. You can see the opinions of previous years' students about the textbook, from their midterm survey, [here](#).

If you do buy the book, either the [E-text](#) (ISBN-13: 9780135161753) or [physical copy](#) (ISBN-13: 9780134874364) is fine. The 9th (most recent) or 8th edition (~\$100 cheaper) will suffice. You do not need to purchase a “Mastering Astronomy” license. Be sure not to order only Part I (“The Solar System”) or Part II (“Stars & Galaxies”) or “The *Essential* Cosmic Perspective” (doesn’t cover everything), all of which are sold separately (check the ISBN).

[Those for whom acquiring the book poses financial difficulties can find help getting a copy here.](#)

Course Components

This course features a combination of asynchronous and synchronous work:

- **The first half hour** of the class meeting periods will be a brief lecture on a new astrophysical concept. The material about a concept is referred to as a “module.”
- The **remainder of each class period** will generally be used as a **problem-solving session** where students will work in small groups to practice solving problems similar to what will be on the quizzes and in the homework. Each of these sessions covers the concepts in one module, for an average of 2 modules per week. The topics of these sessions are indicated in the [course schedule](#).
- **Video lectures, slides, and comprehension quizzes** will be made available through Canvas for the material covered in each module. These can be viewed **asynchronously** and are a supplement to the material covered in lecture. The comprehension quizzes are available for you to test yourself (they can be repeated until you get them right) and are not graded.
- Both I and the TA will hold **office hours**: we’ll review material covered in the prior week and take questions about lectures, in-class problems, homework, and quizzes. These will be scheduled in the first week of class.
- **Homework** will be assigned for each pair of modules, due at least 1 week after we cover these concepts in class. Due dates are in the [course schedule](#).
- **A total of 4 quizzes will be given in class**, about one every 3-4 weeks, to test your independent understanding of the material. For the quizzes, you will need **pen or pencil only (no electronics of any kind)**. You will be able to bring a notes sheet with you (2-sided, 8.5”x11” paper). Quiz dates are highlighted in **yellow** in the [course schedule](#).
- The **cumulative final exam** will take place during exam week.

Communication

- **From me to you**: check for announcements on Canvas and/or email at least once between sessions. 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 can also always ask questions of me or the TA at office hours.

Course Schedule

The [live updated schedule](#) is available as a Google Sheet.

Getting Help

This course is intended to challenge and expand your ability to solve problems using mathematical expressions, to reason using numbers, and to interpret various types of quantitative astronomical data. The approaches you will learn are new to most people who take this class, so if you run into difficulty, **you are not alone**. You have many options for getting additional practice. Here are some resources you can turn to for help:

Office hours: asking questions and getting help on your classwork is precisely what office hours are for! We will offer at least 2 office hours per week, scheduled so that at least one is available to everyone. If discussing a homework problem with ~10-15 other students around still sounds intimidating, feel free to observe a few sessions and you will most likely see that everyone else is asking the same kinds of things you are wondering about!

Your small group partners: you'll be assigned to a group of 4-5 students for our problem-solving sessions. We will do some activities on the first day for you to get to know each other a little, so you feel a bit more comfortable asking for help from each other outside those sessions. Don't hesitate to give help to other people when asked, even if you're not entirely sure of the right answer: ***the best way to learn something is to teach it!***

Math and physics help: the Math Department offers **free** [drop-in Math & Physics help](#) multiple times per week. Getting problem-solving help for this class usually falls in their areas of expertise.

General learning resources: Penn's [Weingarten Learning Resource Center](#) offers **free**: [professional instruction in study skills](#), comprehensive [services for equal access to learning](#) for students with disabilities (self-identified), and [tutoring services](#) (the Math and Physics tutors will likely be able to help you, and I have heard they will offer Astro tutors this semester as well).

Mental health resources: If you broke your leg, you'd go to a doctor. If your mental health needs attention, take it just as seriously. [Penn Counseling and Psychological Services](#), the [Penn Office of the Chaplain/SPARC](#), and the [Penn Reach-A-Peer Helpline](#) offer **free** help.

Financial assistance: Penn offers [emergency and opportunity funding](#) to help students cope with unexpected or unmanageable expenses (such as a broken laptop, winter or professional clothing, application and testing fees, or medical expenses). **Any** enrolled undergraduate, graduate, or professional student is potentially eligible for this financial assistance. Students do **not** need to identify as FGLI or highly aided to apply.

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.

"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](#), Slack, 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/>

Evaluation

Assignments are designed to help you confirm that you understood the material, give opportunities to practice what you learned, and offer feedback on areas for improvement.

**RULE ZERO: DO NOT EMAIL ME ANYTHING IMPORTANT OUTSIDE OF THE CANVAS INBOX.
IT WILL FALL INTO A BLACK HOLE AND DISAPPEAR FOREVER.**

The evaluations are structured so that if you miss an exercise (homework, group work, quizzes) occasionally for whatever reason, it will not significantly affect your grade, so **no late work will be accepted** (electronic submission will be inaccessible after the deadline; email submissions fall under Rule Zero). Solutions to problems will be available after the deadlines where applicable, if you haven't already looked them up online (hint: it's about the journey, not the destination).

In-class problems: you will work in small groups to solve a problem, with help available from me and the TA. The role of "scribe" will rotate among your members over the semester; this person will submit the solution arrived at by the whole group. A **good-faith effort gets full credit** even if you don't get the right answer. The lowest of your scores on the in-class problems will be dropped when calculating your grade (effectively this means **you can be absent from one class** if you need to be for whatever reason).

Homework: Multi-part exercises on the topics covered in class. An **electronic** copy is due approximately 1 week after the class in which it's covered (you can type up your solution, or scan a handwritten one if you think I can read it). The lowest of your homework scores will be dropped when calculating your grade.

Quizzes: In lieu of exams, your independent comprehension of the material will be tested on non-cumulative quizzes each lasting 1 class period. These will be very similar to the problems you solved in groups during class, and less involved than the homework problems. Quizzes will be **closed-book, no electronic devices** permitted (we'll keep track of time for you). You will be allowed a single double-sided 8.5x11 sheet of **notes**. The lowest of your 4 quiz scores will be dropped when calculating your grade.

Final exam: like the quizzes, this will be **closed-book, no electronic devices** permitted; since the exam is **cumulative** you may bring **two** double-sided 8.5x11 **sheets of notes**.

Grading summary

In-class group work (graded on good-faith effort, lowest score dropped)	35%
Homework (graded on correctness, lowest score dropped)	25%
Quizzes (4; lowest score dropped)	25%
Final Exam	15%

Acceptance of Syllabus & Code of Conduct

Please sign, detach, and return this part at the start of the first class you attend.

I have read and understood the syllabus for ASTR 0001 Section 2, Fall 2022. In all matters pertaining to this course, I agree to abide by Penn's Code of Academic Integrity and the course code of conduct, as specified in the "[Academic Integrity](#)" section of the syllabus. I accept that my participation in this course is contingent on following these policies.

Signature

Date

Printed Name

PennKey