

SYLLABUS
Astronomy 201: Cosmology (Tier II Natural Sciences)
The University of Arizona, Spring, 2020

Contact Details:	Peter Behroozi (Instructor)	and	David Ball (TA)
Help Session Room:	Steward Observatory 326		Steward Observatory N317
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Pronouns:	he/him/his		he/him/his
Help sessions:	Thursdays 2-3 PM		Tuesdays 10:30-11:30 AM

LECTURES: MWF from 10:00-10:50am in Steward Observatory, Room N210.

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructors.

COURSE DESCRIPTION:

Cosmology is the study of the origin and evolution of the Universe. We will cover modern knowledge of stars, black holes, galaxies, and spacetime, as well as the human stories of discovery behind this knowledge. We will also review common scientific approaches to understanding the world, and how they are relevant to decision-making on Earth.

LEARNING OUTCOMES:

Upon successful completion of the course, you will be able to:

- describe human motivations to do science, including cosmology;
- describe approaches that helped us understand the Universe, and the relevance of those approaches to your life;
- list major components of the Universe (e.g., planets, stars, galaxies, dark matter, dark energy) and draw relationships between them;
- describe relationships between mass, energy, space, and time;
- describe the future of the Universe and the Solar System;
- improve your ability to speak and write about your knowledge;
- improve your consciousness of and control over how you think.

These learning outcomes will be met through the attendance of lectures, in-class writing, out-of-class guided calculations, an out-of-class letter-writing project, and a final exam.

LECTURES:

Students attending lectures are expected to devote their full attention to learning. **Cell phones and laptops may not be used or visible during class, unless you have specific accommodation from the Disability Resource Center.** Students disobeying this rule will lose participation points for the day, and in case of multiple infractions may be administratively withdrawn from the class.

IN-CLASS WRITING:

Many class lectures will contain an in-class writing session, which will give participation points for completion. The general topic (but not the specific prompt) will be posted at the beginning of class, so that you can better direct your attention during lectures. Grading will be on a 1-point scale: 1 point for making a reasonable effort to answer the question, and 0 points otherwise. **Up to three missed or 0-point in-class writing assignments will be automatically excused.** These writing assignments will contribute 25% of your final grade.

GUIDED CALCULATIONS:

Science can provide deeper insights into questions that then shape our decisions about the future. We will have weekly homeworks containing guided calculations, partially to help you understand concepts better, and partially to show how science can help with decision-making. Homeworks are due in class on the date indicated on each assignment. If an assignment is turned in late within the same week as the due date (i.e., by Friday 5pm), 10% will be deducted from the assignment's grade. If the assignment is turned in during the following week, 50% will be deducted from the assignment's grade. No points will be given to assignments turned in later than the following week. These homeworks will contribute 25% of your final grade.

HELP SESSIONS:

Help sessions will occur every week, and we strongly encourage you to take advantage of them. We both want you to succeed! We also strongly encourage you to join a group of other students. While all work must be your own, it is a very helpful learning process to compare with other's results and to explain to others why you got the answers you did. Each time you attend a help session and participate, we will increase your average homework grade by 1%, up to a maximum of 10%.

LETTER:

As part of the course, you will be asked to write **and mail** a letter to an important non-family member (e.g., former teacher, coach, pastor, etc.) to describe a scientific advance of your choice and how it has impacted your life. This letter should be at least three single-spaced pages (1500 words) and contain:

- An introduction: why you are writing the letter (“My cosmology class requires us to...”).
- The history of the scientific advance: when and how it was discovered.
- An explanation of how the advance or technology works.
- How the world as a whole was different before and after the advance. You should provide *numerical* examples: e.g., 100,000 lives saved per year.
- The impact of the advance on you, personally: explain how your life would have been much different without the advance.
- Conclusion: thank the teacher/principal for their time spent reading the letter, as well as for their time spent teaching you.

We will give you both a 10% bonus on the letter as well as feedback to help you improve if you give us a draft by **March 25th**. The letter will contribute 15% of your final grade and will be due on **April 8th**.

IN-CLASS QUIZZES:

Several short, in-class quizzes will occur throughout the semester. These will be announced in class, at least a week in advance. You will not be asked to calculate numerical answers on the quizzes, but you may be asked to write paragraph-length responses, label features on graphs, draw connections between topics, and other quantitative questions that do not involve direct calculation. These in-class quizzes will contribute 20% of your final grade; your lowest quiz grade will be automatically dropped.

FINAL EXAM:

The final exam will have two essay questions and one drawing/short-answer question. Here are some examples of what final exam questions **may be like**:

- In what way did this course change the way you think about your own life? Provide specific examples.
- Imagine that you were given Supreme Control of everything **except** Planet Earth (i.e., the other planets in the Solar System, the Sun, the rest of the Milky Way galaxy, etc.) and could move or change anything you wanted. What could you do to make life on Earth better?
- Draw pictures of an ant, an atom, a black hole, the Earth, a galaxy, a human, a neutron star, the Sun, and the entire Universe, **in order of smallest to largest**. For each adjacent pair of pictures, write how many times larger are the sizes of the larger objects (as in distances: e.g., a human's height is X times larger than an ant's). For each of these numbers, write down something on Earth that has the same numerical value within a factor of 10 (e.g., if one object is 100 times larger than another, you could say "The average weight of a human is 137 pounds, which has a similar numerical value.").

The final exam will make up 15% of your grade and take place on May 7th from 8am-10am. You will be allowed one page (front and back) of notes, which you will have to turn in with your exam.

GRADES:

If your average course grade is:

- 90% or better: A
- 80% or better, but less than 90%: B
- 70% or better, but less than 80%: C
- 60% or better, but less than 70%: D
- Less than 60%: F.

If you feel like you are working hard in the course but are not getting at least a C, please come talk to us! We don't want you to struggle in silence. As a reminder, the grading weights are: in-class writing (25%), guided calculations (25%), letter (15%), quizzes (20%), and final exam (15%).

ANONYMOUS COMMENT BOX:

This is a newly-developed version of this course, and so we appreciate your feedback: what works, and what doesn't? If you have thoughts on how to change the structure of the course to make material easier to learn, there is an anonymous comment box on D2L that you may use; alternately, you should always feel free to email one of us directly.

REQUIRED TEXT AND READINGS:

None. The optional textbook is free to download: [OpenStax Astronomy](#).

COURSE WEBSITE:

<http://behroozi.users.hpc.arizona.edu/Classes/ASTR201/>

SCHEDULE:

Subject to change, depending on the time it takes to cover materials in class.

Dates	Topics	Reading
January 15, 17, 22	Syllabus, History of Human Connection to the Sky	Chapter 1
January 24, 27, 29	History of Modern Cosmology; Reference Frames	Chapter 2
January 31 - Feb. 7	Stars	Chapter 16
February 10, 12, 14	Supernovae, Neutron Stars, Black Holes	Chapter 23
February 17, 19, 21	General Relativity and Spacetime	Chapter 24
February 24, 26, 28	Gravitational Waves	Chapter 24
March 2, 4, 6	Galaxies and The Expanding Universe	Chapter 26
March 9-13	Spring Break	
March 16, 18, 20	The Big Bang and Nucleosynthesis	Chapter 29
March 23, 25, 27	<u>Letter draft due</u> (3/25); Dark Matter and Dark Energy	Chapter 25
March 30, April 1, 3	Fate and Future of the Universe	N/A
April 6, 8, 10	Effect of Cosmology on Life	Chapter 30
April 13, 15, 17	<u>Letter due</u> (4/9); Higgs Boson and Particle Physics	N/A
April 20, 22, 24	Quantum Gravity and Theories of Everything	N/A
April 27, 29, May 1	Time Warps and Worm Holes, Remaining Q's	N/A
May 4	Course Review	N/A
May 8	Final Exam (10:30am-12:30pm)	N/A

ACADEMIC HONESTY

We follow the policies outlined in the Dean of Students code of academic integrity, including cases of plagiarism and cheating (see <http://deanofstudents.arizona.edu>). We encourage you to work with your peers on the homeworks. Such collaborations can include a discussion of the qualitative concepts and on the quantitative aspects (i.e., whether you get the same conclusions), but in the end you must do your own work. Academic honesty also extends to printed texts, websites, and video content. If an assignment even only *appears* to be copied from someone else, or copied from a source without a reference, or copied from a referenced source and only a few words changed, then the assignment will be assumed to be plagiarized. We will give a grade of "F" for the assignment, and this may further lead to you receiving an "F" for the course.

ATTENDANCE AND CLASSROOM ETIQUETTE

Students are expected to attend all lectures. As noted above, use of cell phones and laptops in class is not permitted without special accommodation from the Disability Resource Center. Please turn off cell phones in class, and refrain from extraneous talking, distracting/discourteous behavior, and coming late and/or leaving early. **For any occurrences where you know you will have to come late or leave early, please let us know in advance.**

The UA policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>.

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>.

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

ASSISTANCE

We are here to help you, so please take advantage of help sessions. We also want to get to know you, so you are very welcome to stop by to introduce yourself. Please contact us promptly if you have any questions or concerns regarding this class.

If you anticipate barriers related to the format or requirements of this course, please meet with us so that we can discuss ways to ensure your full participation in the course. If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; <https://drc.arizona.edu/>) and notify us of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

The University of Arizona provides a wide variety of resources to help you feel more at home in the UA environment. Examples of student resource/cultural centers include:

- The [African-American Student Affairs Center](#)
- The [Asian & Pacific American Student Affairs Center](#)
- The [Counseling and Psych Services Center](#)
- The [Guerrero Student Center](#)
- The [Immigrant Student Resource Center](#)
- The [LGBTQ+ Student Affairs Center](#)
- The [Native American Student Affairs Center](#)
- The [Think Tank Tutoring Center](#)
- The [Transfer Student Center](#)
- The [Veterans Education and Transition Services Center](#)
- The [Women & Gender Resource Center](#)

We encourage you to take advantage of the community, support, and learning opportunities afforded by these centers, and to encourage your friends and colleagues to do the same.