

ASTR 320: The History and Philosophy of Astronomical Thought
Fall 2021, Tuesdays and Thursdays 2:00-3:15pm, Steward 204
Instructor: Chris Impey, University Distinguished Professor

Syllabus

This document is the syllabus for the class, acting as a “roadmap” for the semester. It also lays out expectations and requirements as clearly as possible, to avoid miscommunication and any misunderstanding. Consider it our “contract” for the semester. Ask me if anything is unclear!

Summary

ASTR 320 covers the history and philosophy of astronomy, from pre-history to the present. Astronomy is the oldest science, and it continues to be one of the most dynamic, with new discoveries announced almost daily. The philosophical aspect of this course enables us to consider broad and profound questions about the universe and how it operates. This class doesn't require any prior background in astronomy, but it will challenge you with subject matter that ranges from history and logic to quantum theory and relativity (without math). We'll start at a time when people thought the universe was a dome over our heads and end with the possibility of multiple universes. You will be evaluated in this class based on weekly presentations done in VoiceThread, weekly participation, and an end of semester project.

Instructor

Your instructor is Chris Impey, University Distinguished Professor of Astronomy. My brief bio follows. Chris Impey has over 210 refereed publications on observational cosmology, galaxies, and quasars, and his research has been supported by \$20 million in NASA and NSF grants. He has won eleven teaching awards and has taught two online classes with over 300,000 enrolled and four million minutes of video lectures watched. Chris Impey is a past Vice President of the American Astronomical Society, and he has been an NSF Distinguished Teaching Scholar, the Carnegie Council's Arizona “Professor of the Year,” and a Howard Hughes Medical Institute Professor. He has written sixty popular articles on cosmology and astrobiology, two textbooks, a novel called *Shadow World*, and eight popular [science books](#): *The Living Cosmos*, *How It Ends*, *Talking About Life*, *How It Began*, *Dreams of Other Worlds*, *Humble Before the Void*, *Beyond: The Future of Space Travel*, and *Einstein's Monsters: The Life and Times of Black Holes*.

Contact

My email is cimpey@as.arizona.edu, and my office is Steward Room 334, office phone number is 621-6522. I respond to emails within 24 hours (and hope you do the same). Office hours will be in my office or on Zoom (see our [D2L](#) course page for the Zoom links) at the following days and times (you can set up appointments at many other possible times if these do not work):
Monday 4-4:30pm, Tuesday 1:30-2pm, Wednesday 4-4:30pm, and Thursday 1:30-2pm.

Textbook

There is no required textbook for this course. But a highly recommended book, available at a reasonable price on [Amazon](#), is *Coming of Age in the Milky Way* by Tim Ferris (Anchor, 2003). The fine narrative and storytelling will enhance your appreciation of the topics of the course.

Structure of the Class

This in-person class meets **2:00-3:15pm Tuesdays and Thursdays**, with a goal of maximizing the time you get to ask questions, have discussions, and work in pairs or small groups. Each week is a new Module and topic for the class. On Tuesdays I will lecture, but there will be plenty of time in the 75-minute session for you to ask questions along the way (rather than waiting to the end) and we can break into discussions too. In this small class, I'd like everyone to feel comfortable interacting with me and each other. If you need to revisit anything we cover, the video lectures are all on D2L. Thursday sessions are given over entirely to discussion. There will be six topics each week (we'll discuss them all) and they will also be the subject of a homework assignment each week, to be done in VoiceThread (you pick one of the six). Homework is due by class time on the following Tuesday. We will also discuss a couple of thought-provoking or out-of-the-box questions. To focus discussion and keep everyone involved, you will form pairs or small groups (no more than three) to consider the topic, then report out to me and the class. The last task is to finish **and submit a semester project by November 30th** on any of the discussion topics from the semester, and present it to the class during one of our last two sessions in early December.

Homework and Project

Your weekly homework will be done using VoiceThread, a collaboration and sharing tool that lets students build online presentations by adding images, videos, audio files, documents and other media to which other users can add comments for discussion. We will be using it to let you be creative and go beyond the normal text format of a homework or paper. [VoiceThread](#) has been integrated into D2L, so you will see the assignments when you visit our course page. For each Module and each week, you will create a presentation in VoiceThread, graded by the instructor, and with comments added by others in the class. Seeing each other's work every week will give you ideas for your presentations. The project, due at the end of the semester, will be a more detailed and well-researched version of the weekly assignment, counting for a larger portion of the grade. The final project should be a multimedia piece of work with text, images, and if appropriate, video or sound. It is not built in VoiceThread but can be uploaded into D2L as a single file, either in pdf, ppt, or standard video (mp4, mov, wmv, avi) format.

Learning Goals

This course is for non-science majors, and it does not assume any prior astronomy knowledge. You may not need astronomy in your life after college, but I hope you gain an appreciation for our understanding of how the universe works. Learning goals are for you to be able to:

- Appreciate the role of logic and science method in advancing astronomy knowledge.
- Understand how different cultures conceived of space and time throughout history.
- Describe how dramatically our view of the universe has changed in the past century.
- Convey aspects of astronomy in a way that any non-science major would understand.
- Recognize the different roles of theory and observation in advancing our knowledge.
- Describe the relationship of astronomy to other fields of science, and also to religion.
- See how science strives for objectivity, but also operates as a human, cultural activity.
- Understand how philosophical thinking can work to advance astronomical knowledge.
- Demonstrate your comprehension of an astronomy topic in a multimedia presentation.

Grading

The final grade will be the sum of the points in three categories. The scale is absolute, in other words, there is no grading curve in this course. The grade and point boundaries on a scale of 100 points are: **A is 90-100 points, B is 80-89 points, C is 65-79 points, and D is 50-64 points.**

Homework assignments and projects should be your own work, not done with other students.

The components of the grade are:

- Weekly VoiceThread assignments 12 in the semester 5 points max 60 points total
- Final Project uploaded to D2L Due Tuesday Dec 1 20 points max 20 points total
- Class participation and engagement In class and online 20 points max 20 points total

The majority of the grade is for the weekly homework assignments in VoiceThread. They will be graded according to a rubric that assigns the 5 points in this way: 1 point for directly addressing the question/topic, 2 points for scientific accuracy, 1 point for including references, citations, or links to justify the arguments, and 1 point for creative and/or multi-modal use of VoiceThread. There are 13 Modules and 13 homework assignments total, the 12 highest scores are counted.

The final project grade will be apportioned in the same ratio, with 4 times more points available for each category. Compared to a weekly assignment, a final project should be more thorough and detailed and have a bibliography or set of references. Topics for the final project can come from any of the questions posed in our weekly Thursday discussions and for homework, or you can choose a different topic entirely. To make sure you are on the right track, everyone should submit a **one-paragraph project title and proposal to me by Thursday, October 15.**

The class participation portion of the grade is to encourage you to stay engaged and contribute regularly to the class discussion. It will be measured by your weekly attendance at the Tuesday and Thursday class sessions (10 points maximum), watching an average of five class videos per week, which includes the lecture videos and YouTube videos (5 points maximum), and making an average of five comments per week on other student's VoiceThread homework assignments (5 points maximum). The breakdown of how these participation points are awarded is below:

Class Attendance	Frequency:	Videos Watched	VT Comments
28-30 sessions attended = 10 pts	5+ per week	65+ total = 5 pts	65+ total = 5pts
26-27 sessions attended = 9 pts	4-5 per week	52-64 total = 4 pts	52-64 total = 4 pts
24-25 sessions attended = 8 pts	3-4 per week	39-51 total = 3 pts	39-51 total = 3 pts
22-23 sessions attended = 7 pts	2-3 per week	26-38 total = 2 pts	26-38 total = 2 pts
21-22 sessions attended = 6 pts	1-2 per week	13-25 total = 1 pts	13-25 total = 1 pts
19-20 sessions attended = 5 pts	<1 per week	<13 total = 0 pts	<13 total = 0 pts

Attendance, participation and engagement are 20% of the grade, a substantial component, but not intended to be punitive. If you come to class regularly, watch an average of five videos each week (there are 6-8 class videos and 6-8 YouTube videos each week), and constructively comment on an average of half of your classmates' VoiceThread homeworks per week, you'll get full credit for your participation. I can excuse any absence if you let me know in advance.

University Information

- **Classroom attendance:**
 - For all information on policies during the evolving COVID situation go to [this link](#).
 - If you feel sick or may have been in contact with someone who is infectious, stay home. Except to seek medical care, avoid contact with others and do not travel.
 - Notify your instructor if you will miss a class meeting or assignment deadline.
 - Non-attendance for any reason does **not** guarantee an automatic extension of due date or rescheduling of examinations/assessments.
 - If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
 - Voluntary and free [COVID-19 testing](#) is available for students on Main Campus.
 - COVID-19 vaccine is available for all students at [Campus Health](#).
 - Visit the [University of Arizona COVID-19](#) page for regular updates.
- **Academic integrity**

Academic Integrity at the University of Arizona is the principle that stands for honesty and ethical behavior in all homework, tests, and assignments. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of dishonesty by others, submitting the work of another person or work previously used without informing the instructor, or tampering with academic work of others. Students found to be dishonest will be reported to the Dean of Students Office and will receive a sanction, such as a failing grade on the assignment, and/or the course. Students should refer to the [University's Code of Academic Integrity](#) if they have questions.
- **Academic advising:** If you have questions about your academic progress this semester, or your chosen degree program, please note that advisors at the [Advising Resource Center](#) can guide you toward university resources to help you succeed.
- **Life challenges:** If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The [Dean of Students Office](#) can be reached at 520-621-2057 or DOS-deanofstudents@email.arizona.edu.
- **Physical and mental-health challenges:** If you face physical or mental health challenges this semester, note that Campus Health provides high quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling and Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.
- **Exams:** There are no exams or quizzes in this class, and there is no final exam. Hooray!
- **Equipment and software requirements:** For this class you will need routine access to the following hardware: laptop, tablet, smartphone or other web-enabled device with webcam and a microphone; regular access to a reliable internet signal; the ability to download and run the following software: any web browser and Adobe Acrobat.

- **Staying current:** Come to weekly class sessions on Tuesday and Thursday. Keep up with watching class videos, YouTube videos, and commenting on VoiceThread assignments of your classmates. If you get behind early, it will be difficult to catch up at the end for full participation credit. Complete VoiceThread homework assignments in D2L by Tuesday deadlines. If you need an extension on any deadline, ask me. Plan your time to finish the semester project by Nov 30. The Work Flow document in D2L helps to budget your time.

Daily Schedule

No.	Date	Day	Topic	Details	Module	Chapter
1	Aug 24	Tue	Overview	Goals, grading, introductions	—	—
2	Aug 26	Thu	<i>Discussion</i>	<i>Our place in space and time</i>		
3	Aug 31	Tue	Ancient Skies	Night sky, archeoastronomy	1	—
4	Sep 2	Thu	<i>Discussion</i>	<i>What early humans knew</i>		
5	Sep 7	Tue	Greek Science	Logic and the scientific method	2	1-2
6	Sep 9	Tue	<i>Discussion</i>	<i>Mathematics and science</i>		
7	Sep 14	Tue	Revolutions	Arab science, Copernicus	3	3-4
8	Sep 16	Thu	<i>Discussion</i>	<i>Science and superstition</i>		
9	Sep 21	Tue	Telescope	Galileo and the telescope	4	5
10	Sep 23	Thu	<i>Discussion</i>	<i>Science and religion</i>		
11	Sep 28	Tue	Gravity	Newton and gravity theory	5	6
12	Sep 30	Thu	<i>Discussion</i>	<i>The clockwork universe</i>		
13	Oct 5	Tue	Evolution	Cyclic vs Linear, age of the Earth	6	12-13
14	Oct 7	Thu	<i>Discussion</i>	<i>The nature of time</i>		
15	Oct 12	Tue	Mapping	Solar System and the Milky Way	7	7-8
16	Oct 14	Thu	<i>Discussion</i>	<i>Science as a profession</i>		
17	Oct 19	Tue	Relativity	Einstein, space and time	8	10
18	Oct 21	Thu	<i>Discussion</i>	<i>Paradigm shifts in science</i>		
19	Oct 26	Tue	Quantum Theory	Modern physics, uncertainty	9	15
20	Oct 28	Thu	<i>Discussion</i>	<i>The nature of physical reality</i>		
21	Nov 2	Tue	Stars and Atoms	Creation of the heavy elements	10	14
22	Nov 4	Thu	<i>Discussion</i>	<i>Telling the story of atoms</i>		
23	Nov 9	Tue	Galaxies	Galaxies, the expanding universe	11	9+11
24	Nov 11	Thu	<i>Discussion</i>	<i>Our place in the universe</i>		
25	Nov 16	Tue	Big Bang	Origin of the universe, inflation	12	16-18
26	Nov 18	Thu	<i>Discussion</i>	<i>The limits of knowledge</i>		
27	Nov 23	Tue	Exoplanets	Life in the universe, SETI	13	19
28	Nov 25	HOL	Turkey Day	Too much eating and family		
29	Nov 30	Tue	<i>Discussion</i>	<i>Implications of life beyond Earth</i>		
30	Dec 2	Thu	Presentations	Final projects (Presented in Class)		
31	Dec 7	Tue	Presentations	Final projects (Presented in Class)		
32	Dec 13	FINAL	No Class Final	—		
33	Dec 15	GRAD	End of course	Final grades are posted on D2L		