

**ASTR 320: The History and Philosophy of Astronomical Thought**  
Fall 2020, 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.

**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 190,000 enrolled and two 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](mailto:cimpey@as.arizona.edu), and my office phone is 621-6522. I will respond to emails within 24 hours (and expect you to do the same). Office hours will be on Zoom (see our course page on [D2L](#)) at the following days and times (you can also set up appointments at many other possible times): ***Monday 4-5pm, Tuesday 1-2pm, Wednesday 4-5pm, and Thursday 1-2pm.***

**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.

## **Class Structure**

This class is designed as a “flipped” class. This means that I will minimize lecturing during our assigned class times of 2:00-3:15pm Tuesday and Thursday, and maximize the time you get to ask questions, have discussions, and work in pairs or small groups. In turn, that means that you will need to watch the videos lectures and YouTube videos in your own time, but ahead of the Tuesday session. For Thursday sessions, I will release a set of topics beforehand for discussion and short homework assignments. They are due by the following Tuesday. The course material is divided into 13 weekly Modules. The videos for each module total 70 to 90 minutes, divided into 6 or 7 shorter topics. There will also be links to YouTube videos on topics in each Module, totaling 35 to 45 minutes of viewing. You’re encouraged to rate and give feedback on lecture videos and YouTube videos. After Thanksgiving, you will be working remotely online. The last task is to finish a project by Dec 1 and present it in one of our last three live Zoom sessions.

## **Class Activities**

Distance or remote learning can be challenging for both students and instructors. This class is designed to give you as many chances as possible for active engagement, both with me and your fellow students. On Tuesdays we will do that in [Zoom](#) with a mini-lecture summary of the content of the Module, with the bulk of the 75-minute session used for questions and answers and discussion. On Thursdays we will also be in Zoom, and you’ll be presented with six possible questions for discussion, designed to be as thought-provoking as possible. These questions are the basis for each week’s homework, due the following Tuesday. The assignments will be built and delivered in VoiceThread (see the next section). You will also do a project in VoiceThread, a more substantial piece of work that will be due near the end of the semester. It can be on any one of the weekly discussion questions, or a topic of your own choosing if you clear it with me first (by Oct 15). There are also Discussion forums, where you can suggest new YouTube videos, brainstorm project ideas, and get your questions answered. There are no multiple-choice tests or timed exams in this class, and there is no final exam. Grades will be posted by December 16.

## **VoiceThread**

VoiceThread is 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 term paper. [VoiceThread](#) is integrated into D2L, so you will see the assignments when you visit our course page. For each Module and each week, you will be creating a presentation in VoiceThread to be graded by the instructor and for comments to be added by others in the class. Seeing each other’s work every week will give you ideas for your own presentations. The class project, due near the end of the semester, is a more detailed and well-researched version of the weekly assignment, counting for a larger portion of the grade.

## **Weekly Schedule**

The course will follow a fixed pattern for the first 13 weeks, with project presentations during the last three class periods, online from home, after Thanksgiving, December 1<sup>st</sup>, 3<sup>rd</sup>, and 8<sup>th</sup>.

- Tuesdays, Mini-lecture and discussion. Assignment: watch all the videos before class.
- Thursdays, Questions and discussion. Assignment: do a VoiceThread by following class.

## 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.**

The components of the grade are:

- Weekly VoiceThread assignments 12 in the semester 5 points max 60 points total
- Final Project done in VoiceThread Due Tuesday Dec 1 25 points max 25 points total
- Class participation and engagement Evaluated online 15 points max 15 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.

The final project grade will be apportioned in the same ratio, with 5 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 participation in the Tuesday Q&A sessions and discussions (5 points), watching all the class videos (5 points) and comments you make on other student's VoiceThread work submitted as a homework (5 points). This part of the grade is not intended to be punitive. If you watch all the videos, actively participate in at least 10 of the 13 Tuesday sessions, and make an average of 5 comments per week on other students' VoiceThread presentations, you can get 15 points of credit for class participation. If you are unable to participate live in more than three Tuesday sessions, please let me know.

## 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 that you will 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 a non-science major would understand.
- Describe the relationship of astronomy to other fields of science, and also to religion.
- Understand how philosophical thinking can work to advance astronomical knowledge.
- Demonstrate your comprehension of an astronomy topic in a multimedia presentation.

## University Information

- This class is scheduled to be taught in the *flex in-person* modality.
- **Meeting times for remote teaching:** We will be meeting remotely until the University notifies us that in-person meetings may commence. We will meet every Tuesday and Thursday from August 25 through November 24 from 2:00-3:15pm online by Zoom. You are responsible for watching the videos for each Module before the Tuesday class when we discuss that material, and for responding to a question posed in the Thursday class by doing homework in VoiceThread by the next Tuesday. Note: there is no VoiceThread assignment for Module 13. You should also watch the YouTube videos for each module.
- **Meeting times and patterns for in-person teaching:** When the COVID-19 situation permits teaching on campus, we will meet in our assigned room, Steward 204, since it is large enough to allow our small class to meet with suitable social distancing. Our in-class meetings will give us the opportunity to have discussions in a more direct and dynamic way than can be achieved online. Class participation will occur in the classroom but also online when you comment on other students' work in VoiceThread.
- **Face coverings are required in our classroom:** Per UArizona's [Administrative Directive](#), face coverings that cover the nose, mouth, and chin are required to be worn in all learning spaces at the University of Arizona (e.g., in classrooms, laboratories and studios). Any student who violates this directive will be asked to immediately leave the learning space, and they will be allowed to return only when they are wearing a face covering. Subsequent episodes of noncompliance will result in a Student Code of Conduct complaint being filed with the Dean of Students Office, which may result in sanctions being applied. The student will not be able to return to the learning space until the matter is resolved.
- **Physical distancing is required in our classroom:** During our in-person class meetings, we will respect all the CDC guidelines, including restricted seating to increase physical distancing and using appropriately worn face coverings. The [Disability Resource Center](#) is available to explore [face coverings and accessibility considerations](#) if you believe that your disability or medical condition precludes you from utilizing any face covering or mask option. DRC will explore the range of potential options as well as remote course offerings. Should DRC determine an accommodation to this directive is reasonable, DRC will communicate this accommodation with your instructor.
- **Classroom attendance:** If you feel sick or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel. Notify your instructors if you will be missing an in person or online course. [Campus Health](#) is testing for COVID-19. Please call (520) 621-9202 before you visit in person. Visit the [UArizona COVID-19](#) page for regular updates.

- **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](mailto: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 daily access to the following hardware: laptop, tablet, smartphone or other web-enabled device with a 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:** You are required to participate in the weekly class sessions on Tuesday and Thursday, either remotely via Zoom or face-to-face in the classroom if conditions allow it. Keep up with class videos, YouTube videos and readings in *Coming of Age in the Milky Way*. Complete the weekly homework assignments on VoiceThread by Tuesday deadlines. Plan your time suitably to finish the semester project before the deadline of December 1. Also see the “Work Flow” document in D2L to help you budget your time.
- **Remain flexible:** If pandemic conditions warrant, the University may require that we return to remote operations and purely online class. If that is the case, we will notify you by D2L Announcement and email that we are moving to remote operations.
- **Remote/online only after Thanksgiving:** After Thanksgiving, we are scheduled to move to remote teaching. That means that we will meet online using Zoom for the last three class periods: December 1, 3, and 8. Those three sessions will be used for each student to present their semester project to the class. Grades will be posted by December 16.
- **Class Recordings:** For lecture recordings, which are used solely at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All of the recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner that’s inconsistent with UArizona values and educational policies are subject to suspension or civil action.

## Daily Schedule

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

**Last Words:** This is a long document so take time to read it carefully and refer to it as the class gets underway. These are challenging times for students, faculty, and universities in general! Let's make the best of the situation and make the online environment as lively and rewarding as possible. In D2L, there is a separate "Work Flow" document to help you budget your time. How we've learned about the universe is one of the most exciting stories in science, and that quest is one of the greatest human achievements. I hope you learn a lot and enjoy the course.