

How did we get here? The Origins of (Almost) Everything



Astronomy 1559
MWF 10-10:50AM in Clark 101

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Office Hours: Th 2-3:30 (Astronomy 237)
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Office Hours: W 11-12 (Astronomy 222)

Course Description

The astronomer Carl Sagan said that "If you wish to make an apple pie from scratch, you must first create the Universe." What does the origin of an apple pie have to do with the origin of the Universe? What about the Sun and Earth? Where did they come from? How about you? Where did the atoms in your body come from? Are you really made of star stuff? How do astronomers know all this?

From ancient Babylon to modern cosmology, nearly every culture on Earth has stories and myths of creation. It is a universal human desire to understand where we came from and how the world around us came to be. In this course, you will develop and exercise your scientific thinking skills, and gain the resources to understand and participate in discussions of cutting edge scientific discoveries. You'll also learn to separate fact from fiction when it comes to popular science news stories and hone your skills in communicating complicated scientific ideas to your friends and family.

What I want you to get out of this course.

After you leave this course, I want you to continue to seek out and learn new information about cutting edge astronomy research. Here are the goals that I want to help you achieve this semester. You will:

1. Be a scientifically literate member of society
 - a. Find and read reliable general science books or articles (e.g. Scientific American) on astronomy and cosmology and understand the main ideas.
 - b. Be able to explain those main ideas to friends, family, and co-workers .
 - c. Critically assess scientific information as presented to separate science from pseudoscience.

2. Understand that the world is knowable, and that we are coming to know it through observations, experiments, and theory (the nature of scientific inquiry).
 - a. Describe and compare the many methods of science and their roles in scientific inquiry.
 - b. Assess the roles and degrees of uncertainty in science.
 - c. Carry out scientific inquiry and peer evaluation in order to experience the excitement of actually doing science.
3. Gain a cosmic perspective – a broad understanding of the nature, scope and evolution of the Universe, and where you fit in.
 - a. Describe your place in the Universe, in both space and time.
 - b. Demonstrate a broad understanding of the origins of the Universe, stars, planets, and life.

How can you succeed in this course?

Invest in your own learning and participate. What you get out of this course will be directly related to how much you put into it. In order to get the most out of our precious class time, your peers and I will rely on you to come prepared and ready for discussion.

Collaborate with your peers. We will regularly work in collaborative teams. This approach facilitates our learning and mimics your future professional role as a member of interdisciplinary teams whether they be in science, politics, or business. Since you all come from different backgrounds and science experiences, your peers are valuable resources for learning.

Engage with the material. With all of the topics we will cover in this course, I want you to keep these questions in mind: What are the main points? How would I explain those main points to someone not in this class? At times when you had to work at understanding a topic, what thought process led you there? What do you not understand? For material you don't feel completely comfortable with, what action could you take to fill in the gaps in your understanding?

Talk to me. I am committed to helping you achieve your learning goals for this course. I am available during scheduled office hours, office hours by appointment, and via e-mail (sabrinas@virginia.edu). You should let me know what ideas and tools are challenging to you and how you are doing in the class. If you start this habit early in the semester, then I will be able to better tailor our activities to help you learn.

Have fun! At its heart, scientific inquiry involves dreaming up questions about the fundamentals of our universe and then seeking out the answers. It's a pretty sweet gig. Have fun with it.

How will you and I evaluate your progress?

In-class participation (20%) – In order to evaluate your progress in learning each day's concepts, you will be asked to answer short questions before and during each class. You will solve a variety of problems using the Learning Catalytics student response system. These are designed to help you develop your problem solving skills, to encourage you to reflect on your own learning, and to better learn the material, *not* for attendance. Your responses will also provide me with valuable feedback on how I can make the class better.

Weekly Blogs (25%) – The ability to understand and critically analyze popular accounts of science in the media, as well to experience the excitement of actually doing science, are essential for a scientifically literate member of society. Each week, you will have one exercise where you read an article, watch a video, or listen to a podcast. Each week you will write a brief commentary viewed by the entire class and read/comment on your peers work. This will help you prepare for your final digital media project.

Digital Media Team Project (25%) – This semester we are going to create an online magazine called Origins (modeled after www.slate.com). You will be assigned to a group of 4 students. Your group will contribute a piece to the magazine on the astronomical origins of anything in the Universe (your choice). Like an online magazine, the piece must be fresh and engaging. You can write an article (with images) or produce a video, podcast, infographic, animation, or something I didn't think of. Be creative! Your grade will be based on a rubric that we will share with you that assesses the innovation and creativity of your piece, the rigor and importance of the information presented, an evaluation of your supporting resources, peer reviews of other groups work, and responses to the peer review. During the semester, leading up to the final project, you will participate in peer reviews of the project title, short project summary, and draft of the project.

Quizzes (15%) – A crucial part of understanding science in the media is a broad foundation of knowledge on the subject. To assess your understanding of the course content and how to apply it, we will have two quizzes this semester (in class on October 9 and November 13) worth 7.5% each.

Final Exam (15%) – The cumulative final exam will challenge you with a series of short questions and problems to assess your ability to integrate concepts and methods from class discussions and your digital media project.

Course Materials

The required texts are:

Origins: 14 Billion Years of Cosmic Evolution by Neil deGrasse Tyson and Donald Goldsmith

How it Began: A Time Traveler's Guide to the Universe by Chris Impey

You will also be required to download the [Learning Catalytics](#) software onto the web-enabled device of your choice. (You will need to sign up for an account once I give you the proper code.)

Should I bring a screen to class?

We will break up lecture with some in-class exercises accessed through [Learning Catalytics](#) using any web-enabled device. So, we will have screens out.

But ... I would invite you to take notes by hand. This has been proven to be a more effective way of retaining information. The many studies of laptop use in classrooms, all showing negative effects, was summarized in this [New Yorker article](#) written by a CS professor at Dartmouth. I want you to get the most out of our in-class time. Think about what you need to do to achieve that goal.

Course Plan

Here are the topics we will cover this semester. Weekly assignments and reading will be posted in class and on collab.

- 1) How vast is the Universe?
- 2) Where did the Universe come from?
- 3) Where did the Big Bang happen?
- 4) When did the Big Bang happen?
- 5) How does the Universe grow and change?
- 6) Where did matter come from?
- 7) What is dark matter?
- 8) How did our Galaxy form?
- 9) Stars & Apple Pie: Am I made of star stuff?
- 10) Where do black holes come from?
- 11) A Star is Born: Where did our Sun come from?
- 12) How and where do planets form?
- 13) How and when did the Earth form?
- 14) Where and when did life arise on Earth?