

The Space Shuttle and Our Place in the Universe

Credits: Two

Term, Day, Time: Fall 2023, Monday, 2:00-3:50pm

Instructor: Kenneth E. Phillips, Ph.D.

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Location: Waite Phillips Hall (WPH): Room 104

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Where did our Universe come from?

What is our place?

Are we alone?

How do we know what we know?

A WARM WELCOME to this eleven-week, Freshman Seminar on the *Space Shuttle and Our Place in the Universe!* Our course is a broad survey with multiple objectives that require the enthusiastic participation of every student to maximize the opportunity for learning. You will be working in small teams on the final classroom project that will make up the larger percentage of your grade. The course is described fully in the following sections and I urge you to read them carefully and follow up with questions or comments.

COURSE OBJECTIVE: We will examine what I consider the most stimulating questions that one can ask about ourselves as a species and this utterly amazing Universe that we inhabit. We will encourage dialogue and the free exchange of ideas. Critical thinking will guide our discourse. We will hold ourselves to the highest standards of intellectual integrity. And, because this is a credit/no-credit course, I encourage you to be forthcoming with your ideas both verbally and in written form because thinking outside the box will not affect your grade point at USC. **Take a chance—make this count!**

LEARNING IN AN EVOLVING COVID ENVIRONMENT: It is a great pleasure to once again offer in-classroom learning that will let students experience the vibrancy and energy that exemplifies academic study at USC and within the City of Los Angeles—one of the most exciting cities in the world! While we are eager to meet in person, we must acknowledge that new COVID cases continue to be reported on campus although with lower frequency than previously. *This link to the University's COVID-19 Resource Center provides the latest updates and messages.* <https://coronavirus.usc.edu/category/latest/>.

DETAILED COURSE DESCRIPTION: Although designed to be rich in content, this course is about inspiration. If, by the end of our eleven weeks together, you are inspired then you will have understood the real purpose of this course in addition to receiving two credits toward your USC degree. Hopefully, what you learn will make you aware of entire areas of inquiry that you may have overlooked or not formerly considered worthy of your attention. If so, then consider yourself fortunate because there are many follow-on opportunities available to you here at USC and throughout Southern California.

We will explore the struggle to understand our place in the Universe by looking initially through the eyes of ancient tribal peoples and concluding with the U.S. space program as it evolved over the past 65 years reflecting on the distinction between evidence and conjecture because this impacts who we think we are!

Learning Objectives: The learning objectives of this Freshman Seminar include a qualitative understanding of selected scientific concepts that pertain to the exploration of space, the changing perception of our place in the Universe and the tradeoffs that inform a policy of exploration going forward. Students will:

- Explore historical and cultural factors that have shaped our concepts of the Universe.

- Recognize the variety of scientific instruments and spacecraft used for the exploration of space.
- Learn to infer the destination and scientific purpose of a spacecraft based solely on its appearance.
- Distinguish spaceflight hazards that have design solutions from those that do not.
- Learn how a complex program of exploration unfolds through a series of well-defined missions.
- Craft a 50-year *National Space Exploration Plan* for the United States (Final Project).

Attendance: Attendance and class participation are crucial! This will be a fast-moving course that covers a great deal of intellectual ground. Students should not miss more than one class session.

Table-1: Course Schedule

Monday	Session Title (Main Topic or Question)
Week 1 Aug 21 st	Introduction Part-1: A cosmic conversation (<i>Scientists talk with the Universe!</i>) Part-2: A view from Earth (<i>All is not what it seems!</i>)
Week 2 Aug 28 th	The Astronomers (<i>Time, Order, and the search for truth</i>)
Labor Day (September 4th)	
Week 3 Sep 11 th	Scale (<i>How big is our Universe? Where are we? What is our purpose?</i>)
Week 4 Sep 18 th	Our Changing Universe Part-1: Light (<i>the medium and the message</i>) Part-2: Composition (<i>What is our Universe made of?</i>) Part-3: Origins (<i>Where did our Universe come from?</i>)
Week 5 Sep 25 th	Liftoff Part-1: The speed you need (<i>Escape—from where, to what?</i>) Part-2: The art of escape (<i>Rocket Science!</i>) Part-3: New Horizons to Pluto (<i>Chemistry's price for deep space exploration</i>)
Week 6 Oct 2 nd	Robotic Exploration (<i>Get as close as you can, however you can</i>)
Week 7 Oct 9 th	Humans in Space (<i>Protect the crew! protect the crew! protect the crew!</i>)
Week 8 Oct 16 th	California Science Center (<i>Mercury, Gemini, Apollo, and the Space Shuttle</i>)
Week 9 Oct 23 rd	Unsolved Mysteries Part-1: The Event Horizon (<i>The point of no return</i>) Part-2: The search for life (<i>Are we alone?</i>)
Week 10 Oct 30 th	The Profiteers and the Next 50 years Part-1: The profiteers (<i>The private sector's role in the exploration of space</i>) Part-2: The next 50 Years (<i>Student work on Space Exploration Plans</i>)
Week 11 Nov 6 th	Student Final Presentations

- **Week 1 (Introduction)**
 - **(A cosmic conversation)** sets the tone for our class beginning with student introductions and a conversation about space exploration and scientific discourse. We will discuss the role of evidence vs. conjecture in our efforts to understand the Universe and students will share their career aspirations, reasons for taking this course and what they hope to learn.
 - **(A view from Earth)** will examine our place in the Cosmos through the eyes and traditions of indigenous peoples whose ways of life reflect an ancient view of the world. We will explore their creation mythologies with appropriate respect as we come to understand the development of the character of the people and their societies.

- **Week 2 (*The Astronomers*)** will focus on the centuries-long struggle to transform our thinking about the world from conjecture about the cause of events to reliance on the weight of evidence to explain the things that we observe. We will meet some of the characters responsible for this transformation in thinking and spend some time understanding the instruments they created, the data they collected, and the theories they developed. We will take particular notice of a few surprising discoveries that changed our thinking about the Universe.
- **Week 3 (*Scale*)** will address our physical place in the Universe and the nature of our significance as human beings which is the central concern of this course. We will view images that reveal what is known about the farthest reaches of the cosmos and do our best to wrestle with concepts of physical scale, distance, and structure.
- **Week 4 (*Our Changing Universe*)**
 - **(*Light*)** will address how we decode the secret message that light itself carries about the cosmos to help us gain deep insights into the history of our Universe.
 - **(*Composition*)** will focus on some recent cosmic discoveries that radically altered our notion of what we can and cannot see with even our most powerful instruments.
 - **(*Origins*)** explores the Big Bang as the leading theory explaining the beginning of our Universe and its 13.7-billion-year evolution, inviting us to reflect on the interface between science, faith, and our search for truth.
- **Week 5 (*Liftoff*)**
 - **(*The speed you need*)** introduces speed as the fundamental parameter of space travel and sets the stage for understanding one of the most mysterious phenomena in the Universe.
 - **(*The art of escape*)** examines rockets as the primary tool for achieving the speed you need to slip beyond the gravitational pull of the Earth and travel the Universe.
 - **(*New Horizons to Pluto*)** illustrates the constraints posed by traditional chemical rockets and makes the case for new means of propulsion.
- **Week 6 (*Robotic Exploration*)** will focus on the discrete stages of robotic exploration that enable us to learn more about the objects within our own solar system. We will learn to recognize the components common to all planetary probes thereby enabling a reasonable inference about where in the solar system they went and what scientific measurements they most likely made.
- **Week 7 (*Humans in Space*)** will address the dangers of human spaceflight and the steps required to protect astronauts and cosmonauts during space missions. We will explore the lethal and chronic conditions that plague all space explorers and examine some design strategies and operating practices that address these problems.
- **Week 8 (*California Science Center trip*)**
 - **(*Mercury, Gemini, and Apollo*)** will focus on the three programs that culminated in the successful landing of astronauts on the moon between 1969 and 1972.
 - **(*The Space Shuttle*)** will focus on the 30-year program that took America in a new direction for space exploration. We will dissect the launch sequence and on-orbit operations of the mission profile to understand how the shuttle managed energy and to learn how the purpose of the shuttle differed from previous exploration programs.
- **Week 9 (*Unsolved Mysteries*)**
 - **(*The Event Horizon*)** will build upon the lesson from week-5 (*the speed you need*) to derive the keep-out radius for one of the most mysterious objects in the Universe—the black hole.
 - **(*The Search for Life*)** will describe a method for thinking about the number of intelligent civilizations that might occupy our galaxy and recent discoveries that make the prospect of finding such life forms so compelling.

- **Week 10 (The Profiteers and the Next 50 Years)**
 - **(The Profiteers)** will address SpaceX, Blue Origin and other private sector companies that are making substantial progress in space exploration through partnership with NASA.
 - **(The Next 50 Years)** will provide students with a chance to prepare their National Space Exploration Plans and ask questions regarding any aspect of the class. The momentum from this class will help students carry forward with their follow-up out-of-class meetings to complete their presentations.
- **Week 11 (National Space Exploration Plan Final Presentations)** Each group of students will provide a 15-minute presentation describing their 50-year strategic plan for future space exploration. The plans must include a rationale for each area of activity, destinations of interest and some mention of the desired mix of tools to explore the Universe. Budgets are beyond the scope of this seminar.

Course Notes: Course notes will be provided on USC’s Blackboard as PDFs for download. Lectures will be supported with PowerPoint and video. Some audiovisual media may occasionally be posted on Blackboard for download and study prior to class meetings.

Readings: Required reading will be provided as downloadable PDF files available on USC’s Blackboard or via tested links provided with each resource.

Homework Assignment Content: This course is designed to encourage critical thinking that leads to informed opinions about a fairly wide range of topics including the matter of truth, the relative merits of one type of discovery over another, the notion of acceptable risk and the role that one might prefer on a mission team along with the rationale for the choice of that team’s core scientific question. Therefore, homework assignments will usually challenge students to adopt a position on the topic most recently covered in class and produce a one to two-page critical review explaining their opinion/decision.

Table-2: Grading

Assessment	Content	Due Date	Proportion
Participation	Varies	Ongoing assessment	10%
Homework	Topics from prior class	Each Friday (via Blackboard)	40%
Team Presentation	National Space Policy Briefing	Week 11 (in class)	50%

This is a credit/no-credit course. Credit will be given to students who fulfill the assignments, participate in class discussions, and provide thoughtful, organized presentations.

Assignment Credit and Due Date: Homework assignments are due by 11:59pm on the Thursday following class. Late assignments will be accepted through USC’s Blackboard up until 1:59pm on the day of the next class meeting. An automatic 10% reduction in the graded assignment will be applied for each day beyond the official due date of the assignment. No credit will be given for work received after the assignment extension.

Student Teams: Student team members will need to coordinate their out-of-class time to craft their positions on a national policy for space exploration. Students will be evaluated as a team for their class presentation. Students will be evaluated as individuals based on their participation in class and their homework.

3. STUDENT CONDUCT CODE: Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is an academic offense with serious consequences. Please familiarize yourself with *SCampus: USC Student Handbook (effective July 30, 2021) Part B Student Conduct Code* <https://policy.usc.edu/wp-content/uploads/2021/08/SCampus-Part-B-Student-Conduct-Code.pdf>.

4. SAFETY: Discrimination, sexual assault and harassment are not tolerated by the University. You are encouraged to report any incidents to the *Office of Equity, Equal Opportunity, and Title IX (EEO-TIX)* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://dps.usc.edu>. This is important for the safety of the whole USC community.

24-hour Emergency Phone Numbers are:

University Park Campus (UPC): 213-740-4321 and

Health Sciences Campus (HSC): 323-442-1000

Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Relationship and Sexual Violence Prevention and Services (RSVP)* team <https://studenthealth.usc.edu/sexual-assault/> is located in the USC Engemann Student Health Center Suite 356 and is available 24/7 to provide **confidential support**.

5. SUPPORT SYSTEMS:

- **Writing:** A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more.
- **Language:** Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali> which sponsors courses and workshops specifically for international graduate students.
- **Emergencies:** If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <https://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.
- **Disability Services & Programs:** *The Office of Disability Services and Programs (DSP)* provides certification for students with disabilities and helps arrange the relevant accommodations. The DSP campus address is 3601 Watt Way, Grace Ford Salvatori Hall, Room #120. Please refer to the following link: <https://dsp.usc.edu>.
- **International Offices:** The *USC International Offices* promote and facilitate the university's global engagement by supporting recruitment, cultivating local relationships and facilitating academic activities. It has offices in Beijing, Hong Kong, London, Mexico City, India, Sao Paulo, Seoul, Shanghai and Taipei. <https://global.usc.edu/global-presence/international-offices/>

6. FACULTY LAISONS: All classes in the Department of Physics & Astronomy have an assigned Faculty Liaison to serve students as a confidential, neutral, informal, and independent resource when they wish to discuss issues concerning their course without directly confronting their instructor. The Faculty Liaison for this class is Dr. Jack Feinberg, feinberg@usc.edu, 213-740-1134, SSC 327

NOTE ABOUT LINKS: All links have been tested and proven operational at the time of this posting. If any links do not launch directly from this document, then please copy and insert directly into a browser. I urge you to test the links and to become generally familiar with their content.