

## ASTR/GEOS/PTYS 214 – Life in the Cosmos – Fall 2023

### Special OSIRIS-REx Edition!

Kuiper 308 – T-Th – 9:30 - 10:45 am

#### Description of Course

This course explores key questions in astrobiology and planetary science about the origin and evolution of life on Earth and the possibility that such phenomena have arisen elsewhere in the Universe. We examine what it means for a planet to be alive at scales ranging from cellular processes up to global impacts of biological activity. We consider space-exploration activities to search for life within the Solar System, throughout our Galaxy, and beyond from various cultural perspectives.

This course is in the *Building Connections* Curriculum Category in the University's General Education Curriculum. It includes both *World Cultures & Societies* and *Quantitative Reasoning* attributes. It is also a *Tier II Natural Science* course in the previous curriculum. The course is equivalent to ASTR 202 (students may not receive credit for both courses).

**Special Edition** – The instructor is the principal investigator for NASA's OSIRIS-REx asteroid sample return missions. After a seven-year journey to near-Earth asteroid Bennu and back, these samples will be delivered to Earth on September 24, 2023. Students will get a first-hand account of these activities, and the follow-on science. In addition, the Quantitative Reasoning Signature Assignment focuses on laboratory analysis of the returned samples to address astrobiological questions.

#### Course Prerequisites or Co-requisites

None

#### Instructor and Contact Information

**Instructor:** Professor Dante Lauretta, Lunar and Planetary Laboratory, University of Arizona

**Office:** Kuiper Building (1629 E University Blvd) 536

**Email:** [lauretta@arizona.edu](mailto:lauretta@arizona.edu)

**Office Hours:** Wednesday: 9 – 10 am (in person), Thursday: 4 – 5 pm (Zoom), and by appointment (Zoom or in person): contact Dante to schedule.

**Teaching Assistant:** Sawsan Wehbi, Dept of Molecular and Cellular Biology, University of Arizona

**Office:** TBD

**Email:** [sawsanwehbi@arizona.edu](mailto:sawsanwehbi@arizona.edu)

**Office Hours:** TBD

**Preceptors:** Scott Petersen

**Email:** [scottyp123@arizona.edu](mailto:scottyp123@arizona.edu)

#### Web Information

<https://d2l.arizona.edu/d2l/home/1303276>

## Course Communications

The instructor is available during office hours, via email, and by appointment. All course material will be posted on D2L. Instructor and TA presentations will be delivered in person. Grades will be updated regularly on D2L. Students are expected to work in small groups outside of class for the Laboratory Design project. The instructor can assist students in setting up these breakout meetings.

## Course Format and Teaching Methods

The course content will be a combination of innovative delivery from the instructor, active learning both in and out of the classroom, and collaborative team projects. Content will combine Geology, Atmospheric Science, Biology, Neuroscience, Technology, and Cultural Studies.

The course content will be presented and evaluated through a combination of:

- TED-style talks focused on *Key Questions* in astrobiology
- Guest presenters on astrobiological phenomena
- In-class activities
- Online posting and discussions
- Semi-weekly written reflections
- Group projects with regular video and written reports

Details are provided in the following sections.

## Course Objectives

During this course students will:

- Identify and interrelate the wide variety of disciplines that address the fundamental questions:
  - Where did we come from?
  - What is the meaning of life?
  - Are we alone in the Universe?
- Communicate and justify how interdisciplinary approaches contribute to understanding the origin and history of life on Earth.
- Use core values, concepts, theories, and quantitative methods from planetary science and biology to identify promising targets in the search for extraterrestrial life.
- Examine the role and importance of astrobiology from various cultural perspectives.
- Engage in critical and conceptual thinking about the societal impact of discovering life on another planet.

## Expected Learning Outcomes

Students will demonstrate:

- The ability to utilize multiple perspectives and make meaningful connections across disciplines and social positions, think conceptually and critically, and solve problems
- Competency in working with numerical information by critically analyzing quantitative information, generating ideas that are supported by quantitative evidence, assessing the relevance of data and its associated implications in a variety of contexts, and communicating those ideas and/or associated interpretations using various formats (graphs, data tables, illustrations, video presentations, or written reflections).
- Understanding of the values, practices, and/or cultural products of at least one non-US culture/society with an astrobiology or space exploration program; relate how these values, practices and/or cultural products have shaped their space exploration activities; and reflect on how the student's own background has influenced their perceptions of other societies and their sense of place in the global community.

## Makeup Policy for Students Who Register Late

Students who register after the first-class meeting may make up missed assignments within one week of joining the class. They will also be able to join any existing activities related to mission team formation and assignment of roles and responsibilities.

## Key Questions Drive the Course Content

Date	#	Key Question	Padlet Due	Reflection Due
8/22/23		OSIRIS-REx Status Report		
8/24/23	1	What is Life?	#1	
8/29/23	2	How did the building blocks of life arrive on Earth?		
8/31/23	3	How did life originate?	#2	
9/5/23	4	How did the Solar System form?		
9/7/23	5	How did the Earth form?	#3	
9/12/23	6	What role do quantum effects play in life?		#1
9/14/23	7	What is the role of matter and energy in life?	#4	
9/19/23	8	What is the role of information in life?		
9/21/23	9	What are the range of extreme conditions for life on Earth?	#5	
9/26/23		OSIRIS-REx Status Report		
9/28/23		Team Lab Status Report #1		
10/3/23	10	How do we know there are oceans elsewhere in the Solar System?		
10/5/23	11	Why is matter conscious?	#6	#2
10/10/23	12	When and how did intelligence evolve?		
10/12/23	13	How did Earth's atmosphere reach its current composition?	#7	
10/17/23	14	Where is the best place to find life outside the Solar System?		
10/19/23	15	When and how did the nervous system evolve?	#8	
10/24/23		OSIRIS-REx Status Report		#3
10/26/23		Team Lab Status Report #2		
10/31/23	16	When and how did life move to land?		
11/2/23	17	What might life look like on ancient and current-day Mars?	#9	
11/7/23	18	How did plants, fungi, and animals evolve?		
11/9/23	19	Did an asteroid kill the dinosaurs?	#10	
11/14/23	20	Can life spread beyond a planet?		#4
11/16/23	21	How did the mammals evolve?	#11	
11/21/23		OSIRIS-REx Status Report		
11/23/23		THANKSGIVING – NO CLASS		
11/28/23	22	How did technology evolve?		
11/30/23	23	How can we detect ET technology?	#12	
12/5/23	24	Can we make synthetic life?		#5
12/12/23		Team Lab Final Report (Note: 8 am start time)		
Legend		Instructor out of town, office hours by Zoom appointment		
		Guest Lectures		
		OSIRIS-REx Status Report		
		Lab Status Report		
		Holiday – no class		

## Required Texts or Readings

Weekly Padlet posting and commenting

## Instructor's Reading Recommendations

Brusatte, Steve. "The Rise and Reign of the Mammals: A New History, from the Shadow of the Dinosaurs to Us." Mariner Books (2022)

Deamer, David. "Origin of Life: What Everyone Needs to Know." Oxford University Press (2020)

Godfrey-Smith, Peter. "Metazoa: Animal Life and the Birth of the Mind." Farrar, Straus, and Giroux (2020).

Harris, Ananka. "Conscious: A Brief Guide to the Fundamental Mystery of the Mind." Harper (2019)

Kershnerbaum, Arik. "The Zoologist's Guide to the Galaxy: What Animals on Earth Reveal About Aliens – and Ourselves." Penguin Press (2021)

Lane, Nick. "The Vital Question: Energy, Evolution, and the Origins of Complex Life." WW Norton & Company (2015).

McFadden, Johnjoe, and Jim Al-Khalili. "Life on the Edge: the Coming of Age of Quantum Biology." Crown Publishing Group (NY), 2016.

Scharf, Caleb. "The Ascent of Information: Books, Bits, Genes, Machines, and Life's Unending Algorithm." Riverhead Books (2021).

Zimmer, Carl. "Life's Edge: The Search for What It Means to Be Alive." (2021).

## Required or Special Materials

Preparation of recorded video presentations for in-class reports

## Assignments and Examinations: Schedule/Due Dates

Student assessment will be based on performance in four areas: In-class Activities, Padlet Postings, *World Cultures & Societies* Signature Assignment, and the *Quantitative Reasoning* Signature Assignment

**In-class Activities (20% of Final Grade)** – Students will explore the *Key Questions* through in-class group activities. These activities are designed to engage the class in topics using student-driven ideas, inquiries, questions, and contexts. A short summary from each group will be submitted at the end of each class and graded for the *In-class Activities* fraction of the grade.

**Padlet Postings (20% of Final Grade)** – Student engagement with each key question will be enhanced through posting, reading, and responding to content on the class Padlet site. Each week a new Padlet layout will be generated, centered around the Key Questions. Each question will have multi-disciplinary ways to approach the answer. Students will post and interact with content in one of these areas:

- Geology
- Atmospheric Science
- Biology
- Neuroscience
- Technology
- Society/Culture

Content can be online articles, videos, podcasts, creative work, or any appropriate and credible source. Highlights from this content will be incorporated into the class discussions. Students will be responsible for twelve such posts, two in each of the six categories listed above throughout the semester. Students must submit a summary of their Padlet work each week on D2L. These submissions will be graded for the *Padlet Postings* fraction of the grade.

### Signature Assignments

There are two signature assignments in this course.

**The *World Cultures & Societies Signature Assignment (30% of Final Grade)*** – This assignment is an *Individual and Cultural Reflection Journal*. The search for life in the cosmos motivates research and inquiry across the world. Space exploration and science more generally connect to cultural and societal values and narratives. Examination of these different approaches allows students to see both cultural biases and the common interests that drive humans to understand our origins and seek life outside planet Earth. Students will describe, from their own perspective, the benefits and challenges of confronting some of the most vexing questions facing humanity. They will then describe, from one or multiple cultural perspectives, the values and practices that emerge from seeking answers to these questions. Students will submit a journal entry every two weeks. These regular submissions will be graded along with the *Final Reflection* to determine the *World Cultures & Societies Signature Assignment* fraction of the grade (30%).

**The *Quantitative Reasoning Signature Assignment (30% of Final Grade)*** – This assignment involves the design of an astrobiology laboratory investigation using the samples returned from asteroid Bennu by the OSIRIS-Rex mission. This assignment has both an individual and a group component. For the individual component, each student will develop, articulate, and investigate their own *Key Question* related to the history of the solar system and life on Earth. Students will then team up to work together as a laboratory group to define a series of measurements that addresses all their collective Key Questions. Each team will provide regular *Laboratory Status Reports* on their progress three times throughout the semester. These reports will include graphical and video components. The instructor will select a subset of the videos to show and discuss in class. Each student will also submit a *Laboratory Individual Contribution Summary* at each *Status Report* deadline. These reports will be graded to determine the *Quantitative Reasoning Signature Assignment* fraction of the grade (30%).

### Revisions

Students will have an opportunity to revise their *Individual and Cultural Reflection Journals* and their *Mission Individual Contribution Summaries*, in response to instructor feedback. Students may resubmit their revised report within two weeks for reconsideration of the initial assigned grade.

### Honors Credit

Students taking this course for Honors Credit should enroll in Section 002 of ASTR, GEOS, or PTYS 214.

### Jovian Satellites Observation Project (TBD)

Students enrolled in an Honors section will participate in a telescopic observing campaign of the moons of Jupiter. Students will take images of Jupiter and its moons during evening telescope observing sessions organized for this class on the UA Mall outside the Kuiper building. Images will be taken once each night over a roughly 18-day period, observing as the four largest moons orbit around Jupiter. Each image of the Jovian system through the telescope must be accompanied by a selfie of the student observer with the telescope in the background on the same night. Students will produce a time lapse animation and an accompanying explanatory video demonstrating how and why the positions change. Students must complete this assignment to receive Honors credit.

## Grading Scale and Policies

Final grades will be calculated based on:

20%: *In-class Activities*

20%: *Padlet Postings*

30%: *World Cultures & Societies* Signature Assignment

30%: *Quantitative Reasoning* Signature Assignment

The grade distribution for the course is as follows:

A:	≥90%	= excellent (regular grade)
B:	≥80% – <90%	= good (regular grade)
C:	≥70% – <80%	= satisfactory (regular grade)
D:	≥60% – <70%	= poor (regular grade)
E:	<60%	= failure (regular grade)

## Incomplete (I) or Withdrawal (W):

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

## Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

## Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

### **Campus Health**

<http://www.health.arizona.edu/>

Campus Health provides quality medical and mental health care through virtual and in-person care.

Phone: 520-621-9202

### **Counseling and Psych Services (CAPS)**

<https://health.arizona.edu/counseling-psych-services>

If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care, including short-term counseling services.

For medical appointments: 520-621-9202.

For After Hours care: 520-570-7898.

For the Counseling & Psych Services (CAPS) 24/7 hotline: 520-621-3334.

### **The Dean of Students Office's Student Assistance Program and Life challenges**

<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services. 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.

Email: [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu)

Phone: 520-621-7057

### **Survivor Advocacy Program**

<https://survivoradvocacy.arizona.edu/>

The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.

Email: [survivoradvocacy@email.arizona.edu](mailto:survivoradvocacy@email.arizona.edu)

Phone: 520-621-5767

### **Academic Advising**

If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to [advising@arizona.edu](mailto:advising@arizona.edu)

### COVID Mitigation Efforts

As we enter the Fall semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit <https://covid19.arizona.edu/> for the latest guidance.

### Confidentiality of Student Records

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

### University-wide Policies link

Links to the following UA policies are provided here, <https://academicaffairs.arizona.edu/syllabus-policies>:

- Absence and Class Participation Policies
- Threatening Behavior Policy
- Accessibility and Accommodations Policy
- Code of Academic Integrity
- Nondiscrimination and Anti-Harassment Policy
- Subject to Change Statement

### 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 instructor(s) if you will be missing a course meeting or an assignment deadline.

- Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of examinations/assessments.
- Please communicate and coordinate any request directly with your instructor.
- 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](mailto:DOS-deanofstudents@email.arizona.edu) to share documentation about the challenges you are facing.
- Voluntary, free, and convenient COVID-19 testing is available for students on Main Campus.
- COVID-19 vaccine is available for all students at Campus Health.
- Visit the UArizona COVID-19 page for regular updates.