

# AST 184L: Life in the Universe Lab



College of the  
Environment, Forestry,  
and Natural Sciences

**College of the Environment, Forestry, & Natural Sciences**  
**Department of Astronomy and Planetary Science**

**Semester:** Fall 2019

**Prerequisites/Co-Requisites:** AST 183: Life in the Universe

**Location:** Physical Sciences Bldg, Rm. 321/232

**Meeting Time & Format:** Tuesdays, 6:30pm – 9:00pm (1 credit hour)

**Instructor:** Alissa Roegge, ar3283@nau.edu

**Office Location:** Peterson 205

**Office Hours:** By appointment (will be scheduled shortly)

**Undergraduate Teaching Assistant (TA):** Anna Ross, asr99@nau.edu

**TA Office Hours:** TBD

**Faculty Supervisor:** Dr. Mark Salvatore

**Faculty Supervisor, Office Location:** Physical Sciences Bldg. (Bldg. #19), Rm. 225A

**Faculty Supervisor, Office Hours:** Thursdays 1:00pm – 2:30pm (by appointment), Fridays 10:00am – 12:00pm (walk-in).

## **Course Purpose & Description (Fall, 2019)**

This course is a laboratory complement to the lecture course AST 183: Life in the Universe, a multidisciplinary exploration of modern scientific inquiry into the question of life's origin, evolution, and future place in the universe. Students will participate in a hands-on introductory study of primary evidence that has shaped a modern scientific view of life's place in the universe. This course uses the exceptional environment of Northern Arizona – its dark skies, deep sedimentary rock exposures, meteor impact record, volcanic terrain, and nearby halophilic organisms – as a unique laboratory wherein students will have direct contact with the kinds of data used to draw diverse astrobiological conclusions. The lab course will also include two mandatory, all-day field trips to occur on two weekends. The focus of this lab course is on (1) the astronomical setting for life as we know it; (2) nearby stars and the prospects for life; (3) environmental impacts of comets, meteorites, and asteroids in the solar system; (4) the evidence used to construct our picture of the history of complex life on Earth; and (5) evidence that differentiates between volcanic and impact origin for craters on Earth. Letter grade only.

## **Course Objectives & Learning Outcomes**

This course has several objectives and learning outcomes that will be addressed during the lab sections and assessed through lab reports and quizzes. Students will be assessed on their critical and creative thinking, quantitative analysis, use of technology, and scientific inquiry, with an added focus on environmental consciousness. By the end of the semester:

- Students will be able to identify and spatially visualize (through dark-sky observations) the cosmological setting of life on planet Earth, including the orientation and simple motions of the Earth in the plane of the solar system, our location and orientation in the Milky Way Galaxy, and the location of the nearest galaxies (scientific inquiry, critical and creative thinking).
- Students will be able to explain evidence for the distances to the nearest stellar systems and identify their stellar magnitudes within visible range. They will be able to identify stellar colors and explain their corresponding spectral types and evolutionary pathway. They will use this information to draw inferences about the suitability of various kinds of stars for harboring extraterrestrial life (creative and critical thinking, quantitative analysis, use of technology, and scientific inquiry).
- Students will exhibit mastery of first-hand evidence for past and current influx of solar system materials in the form of crater morphology and surface densities together with meteor shower count rates. From quantitative considerations of related studies, they will draw conclusions about the positive and negative impact of exogenous materials on life (environmental consciousness, scientific inquiry, critical and creative thinking, and quantitative analysis).

- Students will be able to explain how the chronology of landscape and biological evolution is inferred from sedimentary rock types, fossils, and elementary stratigraphic principles (environmental consciousness, scientific inquiry, and critical and creative thinking).

### **Assessment**

Students will be assessed on the above objectives through a series of lab reports and quizzes. The modes of assessment and how they relate to the content of this course are discussed below.

Lab Reports: Virtually all lab projects will involve lab reports. The lab reports should be turned in at the end of the lab period or the following week as indicated by the instructor. Field lab assignments may be given as take-home projects; these are to be completed outside of class and turned in as directed.

Lab Follow-Up and Surveys: Most labs, including field trips, will be followed by an online survey, quiz, or assignment. Assignments are mandatory and may account for up to 25% of the value of the corresponding lab. Surveys are optional but may be worth extra credit! These are your opportunities to provide feedback on the course and allow you to make the class more enjoyable.

End of Semester Quiz: A comprehensive quiz covering conceptual material from the lab assignments will be given during one of the last lab periods.

**Grading System:** The breakdown of percentage points is as follows:

<i>Classroom Lab Reports &amp; Assignments</i>	<i>65%</i>
<i>Field Trip Lab Reports &amp; Assignments</i>	<i>25%</i>
<i>Final Quiz</i>	<i>10%</i>
<b><i>Total</i></b>	<b><i>100%</i></b>

### **Class, Departmental, & University Policies**

- Please disclose any disabilities or special requirements to the NAU Disabilities Resources Office, who will contact me privately regarding any accommodations. I want to make sure that every student has an equal opportunity to learn and succeed.
- Don't cheat. You're paying good money to learn, and if you don't appreciate the knowledge gained right now, you will in the future. *If you feel like you need to cheat in order to succeed in this class, come talk to the professor to establish a more sustainable plan for succeeding.*
- Students are required to attend both field trips and all in-class labs, and will be graded on the basis of participation.
- As a courtesy to the instructor and to your fellow students, please come to class on time.
- Lab write-ups will be accepted late, but with points deducted for each working day that the assignment is late. Make-ups will only be given for institutional or documented and appropriate reasons. Prior written documentation must be supplied for institutional excuses, while other forms of documentation (e.g., medical notes) may be excepted afterwards.
- Please silence all cellular devices during class. Please refrain from any other "electronic distractions" (e.g., text messaging, browsing social media) during class. If you are anticipating cellular disruptions during class for any personal or professional reasons, please notify the professor prior to class.
- Class disruptions are defined as activities that distract the instructor or other students from delivering or learning the course materials. Such activities include talking or whispering during class, habitual tardiness or leaving class early, or "electronic distractions." Disruptive students will be asked to leave the classroom, and repeat offenders may be withdrawn from the class.
- Neither audio nor video recording will be permitted except under special circumstances prescribed by the NAU Disability Resources Office or discussed with the professor prior to class.
- **Additional departmental and university policies can be found at [www.physics.nau.edu/SYLLABI/POLICY/policy.html](http://www.physics.nau.edu/SYLLABI/POLICY/policy.html).** This course falls under all departmental and university policies unless otherwise stated in this document.
- NAU's Safe Working and Learning Environment Policy (SWALE) prohibits discrimination and harassment, including sexual harassment, on the basis of sex, race, color, age, national origin,

religion, sexual orientation, gender, gender identity, disability, or veteran status by anyone at this university. Retaliation of any kind as a result of making a complaint under the policy or participating in an investigation is also prohibited by SWALE. The Equity and Access Office (EAO) handles complaints of discrimination and harassment that fall under the SWALE policy and also assists with religious accommodations.

- Title IX and NAU prohibit discrimination based on sex or gender in any education program or activity receiving federal financial assistance. Sex discrimination includes sexual harassment, sexual assault, relationship violence and stalking. The Title IX Coordinator is EAO Director, Pamela Heinonen. The Title IX Coordinator has overall responsibility for Title IX compliance, including training, education, and administration of grievance procedures.
- University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In the course of college studies, students can expect to encounter -and critically appraise- materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.
- Everyone has the right to be addressed and referred to by their correct name and pronouns. Class rosters have a student's legal first name, unless they have entered a preferred/chosen first name on SPIRE. Pronouns are not included on rosters, so students will be asked to indicate the pronouns that they use for themselves whenever they are asked to share their names. A student's chosen name and pronouns are to be respected at all times in the classroom.

## Course Schedule

The following course schedule includes the lab topics, dates of examinations, and the required reading materials. Remember that all readings listed for a given lab must be read prior to class, and students will be held responsible for the content of these readings.

This schedule is subject to change, and any changes will be discussed with the class prior to their implementation.

### Lab

<b>Week</b>	<b>Date</b>	<b>Topic</b>
1	Tu, 08/27/2019	Lab Introduction
2	Tu, 09/03/2019	Classification Schemes as a Scientific Tool
3	Tu, 09/10/2019	The Size of Astronomy
4	Tu, 09/17/2019	Sedimentary Rock Lab
	Sat, 09/21/2019	Field Trip to Grand Canyon
5	Tu, 09/24/2019	Igneous Rock Lab
	Sat, 09/28/2019	Field Trip to Meteor and SP Craters
6	Tu, 10/01/2019	Kepler's Laws
7	Tu, 10/08/2019	Age Relationships on Planetary Surfaces
8	Tu, 10/15/2019	Classification of Stellar Spectra
9	Tu, 10/22/2019	Exploring Mars
10	Tu, 10/29/2019	Habitable Zone Lab
11	Tu, 11/05/2019	Drake Equation Lab
12	Tu, 11/12/2019	<b>FINAL QUIZ</b>

## Lecture

Week	Date	Topic	Reading	HW
1	Tu, 08/27/2019	Course Introduction	Ch. 1	
	Th, 08/29/2019	The Scientific Method	Ch. 2	
2	Tu, 09/03/2019	From Atoms to Zygotes: Introduction to Inorganic and Organic Chemistry	Ch. 3.3, 5.2	
	Th, 09/05/2019	Physical Structure of the Universe	Ch. 3.1-3.2	
3	Tu, 09/10/2019	Physical Structure of the Solar System	Ch. 3.4-3.5, 4.6, 10.1, 10.3	HW #1 Due
	Th, 09/12/2019	Introduction to Terrestrial Geology	Ch. 4.1-4.4	
4	Tu, 09/17/2019	Conditions Resulting in Life on Earth	Ch. 4.4-4.5	Discussion #1 Due
	Th, 09/19/2019	<b>EXAM #1</b>		
5	Tu, 09/24/2019	Defining Life	Ch. 5.1-5.4, 9.4	
	Th, 09/26/2019	The Theory of Evolution	Ch. 5.1, 5.5-5.6	
6	Tu, 10/01/2019	Formation of Life on Earth	Ch. 6.1-6.2	HW #2 Due
	Th, 10/03/2019	Evolution (and Extinctions) of Life on Earth	Ch. 6.3-6.4	
7	Tu, 10/08/2019	Evolution of Humans and Artificial Life	Ch. 6.5-6.6	Discussion #2 Due
	Th, 10/10/2019	Conditions Necessary for Life Outside of Earth?	Ch. 7.1	
8	Tu, 10/15/2019	Life in the Inner Solar System	Ch. 7.2, 10.2	HW #3 Due
	Th, 10/17/2019	Mars: Geologic Evolution	Ch. 8.1-8.2	
9	Tu, 10/22/2019	Mars: Environmental Evolution	Ch. 8.3-8.5	Discussion #3 Due
	Th, 10/24/2019	Life in the Outer Solar System?	Ch. 9	
10	Tu, 10/29/2019	The Future of Life on Earth	Ch. 10.4-10.5	HW #4 Due
	Th, 10/31/2019	<b>EXAM #2</b>		
11	Tu, 11/05/2019	Habitability Outside of Our Solar System	Ch. 11.1-11.3, 11.5	
	Th, 11/07/2019	Habitability of Extrasolar Planets	Ch. 11.4	
12	Tu, 11/12/2019	The Search for Extraterrestrial Life	Ch. 12.1-12.3	Discussion #4 Due
	Th, 11/14/2019	UFOs and Aliens	Ch. 12.4	
13	Tu, 11/19/2019	Human Exploration of Our Solar System	<i>Supplemental Readings</i>	HW #5 Due
	Th, 11/21/2019	Interstellar Travel	Ch. 13.1-13.2	
14	Tu, 11/26/2019	The Fermi Paradox	Ch. 13.3	Discussion #5 Due
	Th, 11/28/2019	<i>University Closed: Thanksgiving Break</i>		
15	Tu, 12/03/2019	<i>Should We Search for Extraterrestrial Life?</i>	<i>Supplemental Readings</i>	HW #6 Due
	Th, 12/05/2019	Final Exam Review		
16	W, 12/11/2019	<b>FINAL EXAM (3:00 pm – 5:00 pm)</b>		