ASTR/GEOL 2040: The Search for Life in the Universe

In *The Search for Life in the Universe*, we will be exploring some of humanity's most persistent questions:

Does life exist on other planets?

How could we find out?

Why is there life on Earth?

How did life on Earth begin?

What makes something "alive"?

What might alien life look like?

In discussing these questions, we'll be exploring many different fields of science — astronomy, biology, geology, physics, mathematics, and philosophy, to name a few. The goal of this course is not for you to become an expert on any one of these topics, but rather for you to engage with a science topics and results in the same way that professional scientists do.

To that end, this course will give you experience with many different aspects of science, including posing questions, suggesting ways to find answers, engaging in discussions and debates, checking results with estimates, and working with your peers. **This is not a course on memorizing facts or formulas, it's a course on thinking scientifically.**

Here are a few of the things that you'll be able to do by the end of the semester:

- Interpret the potential habitability of a planet using observations and data.
- Propose observations that could defend or disprove a scientific theory, and explain why these observations accomplish this.
- Evaluate a scientific argument with skepticism, and make an argument for whether or not it is trustworthy.
- Make and analyze scientific estimates across a variety of contexts.
- Use scaling laws to evaluate the relative importance of different physical quantities

Instructor information

Instructor: Tristan Weber
Office: Duane E122
Office hours: Tuesday, Wednesday, Thursday, 11:00-12:00 (or by appt.)
Email: tristan.weber@colorado.edu

Course information

Class time: Monday to Friday, 2:30 - 4:05
Class location: MUEN E131
Textbooks: No required textbook, but these two books might be useful:
An Introduction to Astrobiology, David A. Rothery, Ed
Life in the Universe, Jeffrey Bennett

Course Approach and Expectations

This course is taught using a focus on collaborative, active learning. **I'm not just going to be talking at you the whole time (yay!)**. Teaching in this way is shown to make learning more effective, more long-lasting, and way more interesting. This also means that a major portion of your work and involvement in the course are going to happen in the classroom each day, and the grading of the course will reflect this.

Points breakdown

In-Class Activities/Participation: ….100 points
Homework: …… 160 points (4 x 40)
Final Essay: …… 50 points
Midterm exam: …….. 50 points
Final Exam:…….. 50 points

Total: …….. 410 points

In-Class Activities/Participation

A large portion of your grade in this course will be based around class activities and discussions. **This does not mean you have to know all the answers during class!** Usually there won't just be one right answer anyway. Rather, these grades can be earned through showing up, putting in effort, and engaging with your classmates and the material. In-Class activities will be graded 80% on completion and 20% on accuracy. In-Class participation will be graded on contribution to class discussion

Homework

Homeworks will be posted on our class Canvas site each week. Assignments can be submitted in person each Wednesday or online by the start of the class period. Late assignments will receive a 50% penalty.

Short-answer responses must be in complete sentences. No question can be answered in a single sentence, but if you're using more than a paragraph or two, think about being more concise.

Math problem answers should show all work and contain explanatory sentences. Use words to describe your thought process, list you assumptions, and justify your answer. For the questions in this class, the thought process is much more important than the exact answer, and partial credit will be given readily for If you choose to handwrite your math problems, legibility is key. It might often best to work out the answer and then write up a clean copy.

Working together on homework is encouraged. Science is a collaborative process, and you are encouraged to work together on problems with your classmates. However, all written work must be in your own words and written (or typed) by your own hand. See the CU Honor Code (below) for information on repercussions for academic misconduct.

Final Grades

The final grades for the course will use a fairly standard scale, based on the points breakdown described above.

90-100% — A-, A, A+
80-90% — B-, B, B+
70-80% — C-, C, C+
60-70% — D-, D, D+
<60% — F

Schedule

Note: As we progress through this course, there might be points when it makes sense to shuffle around some topics, based on how things are going so far. If this happens, I'll notify you through an email and a post on the class Canvas site. Homework Due dates and exam days will not be moving around, though. That would just be too stressful.

Week 1: How We Got to Here
9 July – Introduction and the Drake Equation
10 July – Habitability and the Definition of Life
11 July – How much life is out there? Initial Estimates.
12 July – Life on Earth - How does it work?

Week 2: Looking Outwards
15 July – Life on Earth - What is it like?
16 July – Life on Earth - Origin and History
17 July – The Earth's place in our Solar System - *Homework 1 Due*
18 July – Mars - A habitable world?
19 July – Mars - Searching for signs of life

Week 3: Exploring the Solar System
22 July – Venus
23 July – Icy Moons
24 July – Titan and Searching for Life in our Solar System - *Homework 2 Due*
25 July – Catch up, special topics, and review of course so far.
26 July – Midterm exam

Week 4: Outside Our Reach
29 July – *No Class*
30 July – Exoplanets - How to find them
31 July – Exoplanets - What we've found - *Homework 3 Due*
1 Aug – Exoplanets - What we're looking for
2 Aug – Fermi's Paradox

Week 5: The Future
5 Aug – The Philosophy of Searching for life
6 Aug – Life as we don't know it
7 Aug – What comes next for us? - *Homework 4 Due*
8 Aug – Catchup and Review
9 Aug – Final Exam - *Final Essay Due*

Classroom policies

Absences

Regular attendance to class is vital to success in this course. Many in-class activities depend on collaboration with your classmates, and all material covered during class periods could show up on the exam. That being said, if you are sick, please do not come to class! Notify me, and we can go over the material during office hours. If an emergency requires you to miss an exam or the submission of an assignment, please do your best to notify me **before class**. Accommodation of these absences will be handled on a case-by-case basis.

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, homework assignments should be submitted prior to the due date and exams should be completed as near to their scheduled date as possible. See full details at http://www.colorado.edu/policies/fac_relig.html

Discrimination and harassment

Discrimination and harassment of your colleagues has no place in science and will not be tolerated in this course. If the words or actions of myself or any of your classmates are bothering you, please do inform me or the Office of Discrimination and Harassment, such that the issues can be addressed.

The official CU policy is included below:

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been discriminated against should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://hr.colorado.edu/dh/

Classroom behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the CU policies on classroom behavior and the Student Code of Conduct.

Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

Accommodations

Even if you do not have an official accommodation, please let me know what would make your learning experience better and I will do my best to address it.

The official CU policy is included below:

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional

information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, we will provide alternate due dates upon request for any exams and homework that conflict with a religious holiday. Any material that is missed can be obtained through office hours, either in the allotted time or upon request.