

Extraterrestrial Life

AS172 – Fall 2023

(Updated 9/11/23)



Class Times: MWF 1:00-1:50pm

Location: Miller 014

Professor: Brian DiGiorgio Zanger (he/him)
(call me Brian)

Contact: bzanger@colby.edu

Office hours: Mon 3-4pm, Wed 11am-12pm, Fri 2-3pm
or by drop in/appointment, Mudd 403

TAs: Ben Homand, Grace Gouin

Help sessions: Wed 7-9pm, Mudd 415

Contact: bahoma25@colby.edu, gegoui24@colby.edu

Textbooks: *Life in the Universe*, Bennett & Shostak,
4th ed. (9780134089089)

[Astronomy](#), Openstax, 2nd ed.

Course Summary

Is there other life in the Universe or are we alone?
Spoiler alert: we don't know, but this course will give an overview of our best guesses to answer that question and what we have found out so far. Following the structure of the famous Drake Equation, we will start by learning about the astronomical factors that influence the presence of life before moving onto the geological and chemical factors. We will also consider the philosophical implications of our search for life.

Course Goals

1. **Students will reason through the Drake Equation and provide an estimate of the number of extraterrestrial civilizations in our galaxy.** This is the guiding task of the entire class, so by the end, you should be able to give a realistic answer to this question.
2. **Students will be able to understand and contextualize popular astronomy and astrobiology news stories they come across using information they learned from class.**
After this class, I won't be around to teach you more about astronomy, so I want to give you the tools to understand astronomy information you come across in the future.

Class Structure

The weighting of assignments will be calculated as follows:

- **36%: Homeworks** (8 x 4.5%)
- **20%: Projects** (2 x 15%)
- **20%: Midterm Exams** (2 x 10%)
- **14%: Final Exam** (1 x 14%)
- **10%: Participation** (misc.)

At the end of the course, I will assign you a final grade based on the performance of the class as a whole. **This is not a traditional “curve,”** and will not result in your grade going down. This simply allows me to give credit for understanding even if my assessments are difficult.

We will grade and return assignments **within a week and a half of the stated due date.** This means that a homework due on Thursday will be returned by Monday two weeks after. Late assignments may not follow this schedule.

Your participation grade will be a combination of your completion of in-class worksheets as well as your engagement with classroom activities. You don't necessarily have to raise your hand or participate in all-class discussions if that makes you uncomfortable (although it is certainly encouraged); **if you regularly attend class, complete your worksheets, and participate in group work, you will get full participation credit.**

Course Expectations

Attendance

Attendance is not mandatory for this class, and I will not be taking attendance ever. **You do not have to notify me in any way if you will be missing class.** I understand that things come up, and I trust you to make the decision that is best for you.

However, **I strongly recommend that you attend every class.** The readings will not cover all of the content you will be required to know in the course, so coming to the lectures and taking notes will be beneficial to your learning.

I will do my best to help students who must miss a class by posting my notes from class on Moodle and offering help during office hours and over email.

In-Class Behavior

Participation in class is also highly encouraged.

Actively engaging with the material through questions and group work will greatly facilitate your learning.

I understand that you are a living, breathing human being, so **you are allowed to eat, drink, and take bathroom breaks whenever you need** (you don't need to ask me). I would prefer if you could do these things between classes, but I understand that that may not be how your body or class schedule works. Please be courteous to your classmates by not bringing in anything too distracting for your classmates, and wait until after class if your neighbors find you to be disruptive.

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

Discussion Guidelines

During this class, we will have regular discussions in small groups and as a class. During these discussions, I ask you to use the following guidelines:

1. **Respect the knowledge and experiences of your peers.** Don't interrupt or accost your

classmates. Don't invalidate other people's lives, including identity and pronouns.

2. **Be an equitable group member.** Don't dominate the conversation. If someone is quiet, make sure they can say what they want to say. Make sure everyone understands before moving on.

A Note on Textbooks

In this class, we will be drawing primarily from two different sources for our readings. First is the textbook that was listed as required for the course, *Life in the Universe* by Bennett & Shostak. This book does a good job of diving into the specifics of astrobiology.

However, because that book does not cover astronomy topics to the level of detail that will be necessary, we will also have a number of readings from [Astronomy 2e](#) from Openstax. This book was not listed as required because it is available for free online at the link above. You can read the day's readings either as a series of webpages or as a PDF. You can also order a physical copy of the book if you prefer.

Assignments

Due Dates and Resubmission

Every due date in this class is a recommended due date, meaning that **if you need to turn something in late, there will be no penalty for up to one week, after which they will receive a zero.** I recognize that things may come up in your life that may prevent you from completing an assignment on time, and there is no need to notify me ahead of time. Assignments due by near the end of the class must be turned in by the start of the final exam period. **Assignments not turned in by their recommended due date will be deprioritized for grading and will not be eligible for resubmission.**

However, **I strongly recommend you stick to the recommended due dates as closely as possible.** The due dates are spread out in such a way to make the workload manageable and the learning experience productive, so if you put off a bunch of assignments, you will only be hurting yourself by worsening your comprehension and concentrating your work.

To incentivize you to keep the schedule, **all assignments turned in by their recommended due date can be resubmitted and will receive full credit for all mistakes fixed.** My assignments are designed to help you learn the material, so I would rather reward you for putting in the effort to learn and get things right the second time than penalize you for not understanding something immediately. **You will have 1 week from the time an assignment is graded and returned to resubmit the assignment, and you will only be allowed one resubmission per assignment.**

Assignments turned in after their recommended due date are not eligible for resubmission.

Turning In Assignments

The preferred modes for turning in assignments are either in class at the front of the room or through the corresponding assignment listing on Moodle. If for some reason neither of these options work for you, you can also reach out to discuss other methods.

If submitting electronically, please use a standard file format (preferably .pdf, but I will also accept .jpg, .png, .odt, or .docx). Please do not use proprietary/nonstandard formats like .pages or .heic, as they make grading much more difficult.

Readings

For each class day, you will be assigned readings in our textbook. I highly encourage you to do the reading because educational research shows that learners retain information better when they see it multiple times and in multiple modalities, and the book also contains details that I will gloss over in class. There will be no formal verification of whether you have done the reading, but **you may be assessed on material that is covered in the reading but not in class.**

Weekly Homework

An important part of understanding how the Universe and extraterrestrial life works is to actually work through problems. **Homework is the main learning tool for any physics-based class as it allows you to work through and apply the concepts on your own.**

Each week, you will be assigned a set of problems to be turned in the following Thursday. **Your homework will**

be graded for correctness, but significant partial credit will be given for showing your work. If you don't know how to answer a question, write everything you know anyways and we'll probably find something to give you points for. **Solutions that contain only the answer with no accompanying work/justification will not receive full credit.**

You will receive grades and feedback on your answers and **you will be able to resubmit your homeworks** with the mistakes corrected to earn back full points. I highly encourage all students to do this because learning from your mistakes is key to cementing your understanding of a topic.

You are encouraged to work on these problems in groups, but **you must understand and be able to reproduce everything you write down and turn in.** Don't copy work from someone else verbatim. I have caught plagiarism in every astronomy class I have ever graded for, so I will be able to tell and you will receive a 0 on the whole homework.

In-Class Worksheets

In some classes, we will break off into small groups to work on a worksheet synthesizing the day's information. These worksheets will be **turned in on Thursdays with the corresponding homework assignment** (usually the week after they are given out). You are encouraged to work on these worksheets in groups, both inside and outside of class, and I will be available during office hours to help as well.

You will receive feedback on these worksheets after you turn them in to help you learn, but **the worksheets will only be graded for completion.** Completion of the worksheets will count towards your participation grade, and if you complete most/all of your worksheets you will receive full credit.

Midterms and Final Exam

We will have two midterm exams during the class, one to wrap up our astronomy section and the other for the planetary science section. The midterm exams will take place during a normal class period (see schedule for tentative dates), and the final exam will take place during the assigned finals period (TBD).

All exams will allow a “cheat sheet” as big as a full sheet of paper. This sheet can contain whatever you want, and you can reuse the same sheet for subsequent exams. It does not ever need to be turned in. No electronic devices will be permitted on exams.

Projects

You will be required to complete two projects over the course of the class that will help you engage with astronomy in a non-academic context. For more information, see the Projects page on Moodle.

Accessibility

Accessibility During Class

I like to teach with an active learning style, meaning I will often ask for physical participation from students in some way. Below are the tasks I will be incorporating into my lessons. **If any of these tasks will cause difficulties for you, please let me know as soon as possible** so we can work out a way for you to participate equitably in class.

- Walking about ½ mile / 1 km over the course of about half an hour
- Seeing and interpreting colors
- Engaging in class discussions without voice amplification
- Reading a blackboard

Accessibility for Assignments

When it comes to learning in this class, I will assume that **difference is the norm**. I have attempted to design the assignments in this class to be as flexible as possible in the timing, content, and method for completion, but if you encounter some aspect of the course that is not accessible for you, **please bring it to my attention so we can work out something that will help you learn**. I also honor any accommodation letters that you would like to confidentially bring to my attention. I encourage all students to utilize any and all of the accommodations available to you.

If you are a student with a disability, or think you may have a disability, you are also welcome to initiate this conversation with the Dean of Students Office. The Dean of Students Office works with students with disabilities and faculty members to identify reasonable

accommodations. Please visit their website for contact and other information:

<https://www.colby.edu/studentadvising/student-access-and-disability-services/>.

If you have already been approved for academic accommodations, please connect within the two weeks of the start of the semester so the office can develop an implementation plan.

Conflicts with Class

Athletics: In the case of overlapping commitments between class and athletic competitions, **you must meet with me as soon as possible to discuss these overlaps**. You may request permission to miss class and make up the missed work, but I retain final authority either to grant or to withhold permission.

Mental health: If you are in need of reasonable flexibility due to an emotional situation or an ongoing mental health issue, **please communicate as openly as possible with your Class Dean**, and/or members of the office of Access and Disability Services, preferably in advance of the need, so that we can discuss how your circumstances interface with course requirements. Together, we will consider what is needed and what is possible. If we can discuss the situation, we can manage the situation together.

Religious Holidays: If I have inadvertently scheduled an exam or major deadline that creates a conflict with your religious observances, **please let me know as soon as possible** so that we can make other arrangements. Colby College is supportive of the religious practices of its students, faculty, and staff. The College is committed to ensuring that all students are able to observe their religious beliefs without academic penalty.

Additional Learning Resources

Successful students often use a wide variety of resources when learning. To supplement our readings and in-class content, please consider the following options for further learning:

- **Before or after class or during breaks:** I encourage you to approach me at the front of the room to ask any questions

- **Brian's office hours:** We are happy to discuss any ideas you feel uncomfortable with or help you with any assignments you are confused about. I am also happy to set up a separate meeting or Zoom if you cannot attend office hours
- **TA help sessions:** Our TAs Grace and Ben are available to help with your homework questions regularly, and attending help sessions can connect you with other classmates seeking help
- **Your classmates:** Reach out to your classmates to ask for their help

Additional Support Resources

Colby Counseling Services: College is a stressful time for everyone, so please do not allow academic responsibilities to prevent you from getting help you need. Our Colby Counseling Services staff (207-859-4490) and the staff in the Dean of Studies office (207-859-4560) are available to connect with you. The safety of my students and every member of this community is paramount. If you or someone you know is struggling with thoughts of suicide or may be a danger to themselves or others, please call the on-call counselor immediately (207-859-4490, press '0')."

Sexual Misconduct: Colby College prohibits and **will not tolerate sexual misconduct or gender-based discrimination of any kind**. Colby is legally obligated to investigate sexual misconduct (including, but not limited to, sexual assault and sexual harassment) and other specific forms of behavior that violate federal and state laws (Title IX and Title VII, and the Maine Human Rights Act). Such behavior also requires the College to fulfill certain obligations under two other federal laws, the Violence Against Women Act (VAWA) and the Jeanne Clery Disclosure of Campus Security Policy and Campus Statistics Act (Clery Act). To learn more about what constitutes sexual misconduct or to report an incident, see: www.colby.edu/studentlife/handbook-section/f-sexual-misconduct/.

Confidentiality: I am committed to all Colby students feeling safe, accepted, and included in all aspects of their college experiences, including this course. Colby prohibits and will not tolerate sexual misconduct or gender based discrimination of any kind and is obligated, by federal and state laws, to respond to reports and provide resources to students. **As your professor I am considered a "responsible employee" which requires**

me to report incidence of sexual assault, sexual harassment, dating violence, or stalking to the Title IX Coordinator. If you wish to access confidential support services, you may contact the Counseling Center (207-859-4490), the Title IX Confidential Advocate, Emily Schusterbauer (207-859-4093), the Office of Religious and Spiritual Life (207-859-4272), or Maine's 24/7 Sexual Assault Helpline (1-800-871-7741).

Academic Honesty

What is Plagiarism?

This class is built on a foundation of collaboration and group work, so the barrier between “working together” and “plagiarizing” can sometimes become blurred. Here is how I define it:

Plagiarism is turning in work that you could not reproduce on your own if asked.

You are encouraged to work with fellow classmates when solving problems for worksheets or homework, but **you must understand everything you write down**. Here are some examples of practices I consider to be plagiarism:

- Copying a friend’s homework without understanding what they did
- Writing out a solution from the internet/AI without any modification
- Turning in anything you did not write with your own hand

You are allowed to consult sources other than your class notes and the textbook (in fact, I encourage it). This includes sources like other books, Youtube videos, AI, and whatever else you find on the internet. However, **you cannot simply copy what these sources say word for word**.

Don’t rely too much on math aids like Wolfram Alpha or a calculator. I encourage you to use them in order to make difficult calculations and conversions easier, but **you must still show your work** or I may take points off.

How to Avoid Plagiarism

Graders like me, Grace, and Ben are good at spotting plagiarism. If your work looks too similar to the work of another student, we will notice and compare your assignments in detail. Let me tell you **how to keep us from catching you**:

- Change the formatting of your work
- Change the wording you use if you’re answering a written question
- Write different steps when solving equations

If you do these things, we will probably give you the benefit of the doubt and let it pass.

Why am I telling you how to skirt around our plagiarism checks? Because **changing your writeup so it’s not plagiarism requires you to understand the material!** You have to know what you’re doing to modify an answer so that it’s different but still correct.

Plagiarism Consequences

I will follow the required academic dishonesty policy laid out by the Colby administration. For minor offenses (e.g. non-malicious copying of an answer on a homework), you will receive an “academic negligence”, which will be reviewed by the Academic Integrity office and **result in you getting a 0 on the whole assignment and your final grade in the class being lowered by a full letter grade**. If you receive more than one negligence in your time at Colby, you will be required to meet with the Academic Integrity Coordinators.

If you commit a more serious offense (e.g. copying an entire assignment or violating the rules of an exam), **you will automatically fail the course and receive a mark on your Colby transcript until 6 years after your graduation for everyone (including graduate schools and employers) to see**. Subsequent offenses can lead to suspension or expulsion.

Course Schedule

Below is a timeline of what we will be covering in class as well as various due dates and deadlines. All of this is subject to change, and it will be updated regularly to reflect the current course plan. For readings, B&S indicates that the reading is from Bennet and Shostak, while Openstax means it's from the online book.

	Monday	Wednesday	Friday
9/4-9/8		First day	Properties and requirements for life Read: B&S 5.1 Due: Syllabus Quiz
9/11-9/15	Nuclear fusion Read: Openstax 16.1-16.3	Stellar structure Read: Openstax 15	Light Read: Openstax 5.1-5.5
9/18-9/22	Stellar Spectra Read: Openstax 17.3-17.4	Star formation and Main Sequence Read: Openstax 21.1-21.2	Black body radiation and HR Diagram Read: Openstax 17.2, 18.1, 18.4
9/25-9/29	Stellar evolution of low mass stars Read: Openstax 22, 23.1	High mass stars and supernovas Read: Openstax 22.5, 23.2-23.4	Galaxy formation and large scale structure Read: TBD
10/2-10/6	Galaxy structure Read: TBD	Inner planets Read: TBD	Exam 1
10/9-10-13		Outer planets Read: TBD	Moons Read: TBD
10/16-10/20	Solar system formation Read: TBD Due: Project 1	Transiting exoplanets Read: TBD	Exoplanet radial velocity Read: TBD
10/23-10/27	Earth's interior Read: TBD	Earth's atmosphere Read: TBD	Venus and Mars Read: TBD
10/30-11/3	Habitable zone Read: TBD	Molecular biology Read: TBD	Origins of life Read: TBD
11/6-11/10	Complex life evolution Read: TBD	Radio communication Read: TBD	Rockets Read: TBD
11/13-11/17	Orbits Read: TBD	Human space flight history Read: TBD	Space probes Read: TBD
11/20-11/24	Exam 2		
11/27-12/1	Extra	Extraterrestrial civilizations Read: TBD	Philosophy of extraterrestrial life Read: TBD
12/4-12/8	Other kinds of life Read: TBD	Anthropic principle, multiverse Read: TBD	Extra Due: Project 2
12/11-12/15		Finals	

