ASTRO 140 Life in the Universe
Penn State World Campus
Spring 2019

Official course Description
ASTRO 140 (GN) Life in the Universe (3) The problem of the existence of life beyond Earth is investigated, drawing from recent research in astronomy and other fields. For non-science majors. Prerequisite: ASTRO 001, ASTRO 005 or ASTRO 010

Instructor
Eric Feigelson, Professor of Astronomy & Astrophysics and of Statistics
Students should contact Dr. Feigelson via email either through the Canvas online course environment or through any mailer at edf@astro.psu.edu, Please put "ASTRO 140" in the Subject line. Other forms of contact can be telephone (1-814-865-0162), Skype (my contact name is efeigelson), or personal visit (407 Davey Laboratory, Penn State University, University Park PA 16802 USA).

Credits and prerequisites
ASTRO 140 provides 3 credits at the undergraduate level and satisfies part of the University's General Education Natural Sciences (GN) requirement for a baccalaureate degree. The course is designed for non-science majors who have had a semester or more of science; it is not intended as the students' first university-level science course. Many students have taken a general astronomy class (ASTRO 1, 5, 6, 7, or 10) but also students with classes in Earth sciences, biology, or chemistry are probably also adequately prepared. Please contact the instructor to discuss your background if you do not have the formal prerequisites.

Schedule
There are no face-to-face classes for this World Campus course; it is on-line only. The class follows the University academic calendar (Links to an external site.): class begins Monday August 23, Drop/Add period ends August 28, Thanksgiving Holiday is November 21-27, classes end Friday December 10. There is no Final Exam but there are assignments that must be completed by Tuesday December 14 of Exam Week, . The curriculum is divided into 15 weeks with five Themes (below).

Textbook
An Introduction to Astrobiology, 3rd Edition, edited by David A. Rothery, Iain Gilmour & Mark A. Sephton (Cambridge University Press, 2018, ISBN 978-1108430838, paperback). It is important that students have this book, as we

will read much of it during 12 of the 15 weeks of the course. It can be purchased or rented from PSU World Campus here, Barnes & Noble, Amazon.com or other book vendor. MBS Direct promises rapid delivery even to locations outside of the USA and can be contacted by phone at 1-800-325-3252.

Course Website

The course content, class discussions, quizzes, and the gradebook are all integrated in Penn State's Canvas course management system. Students need to be registered for the course and have an Penn State ACCESS account (Links to an external site.) to log into the course Web site.

Problems and contacts

For academic matters (course content, progress, schedule, grades), contact Dr. Feigelson (see Instructor above). For technical problems relating to the course content website (modules), contact Melissa Hicks at the Eberly College of Science Office of Digital Learning. For technical matters relating to the Canvas course management system, contact the World Campus Helpdesk. For technical computer and software requirements, see http://www.worldcampus.psu.edu/general-technical-requirements. For matters relating to World Campus registration or payments, contact Penn State World Campus. Response is usually within a day but could be longer.

Course Overview

The possible existence of life beyond Earth is one of the most fundamental questions relating human beings to the physical Universe around us. While considerations of extraterrestrial life were in the domains of philosophy and science fiction in the past, today we have considerable scientific knowledge that can be applied to the question. Advances in modern astronomy have dramatically improved our understanding of our cosmic surroundings: most importantly we now know (in the past decade) that most stars we see at night have their own planetary systems, and some of appear to be habitable. Several fields -- geology, biochemistry, paleontology (fossils), evolutionary biology -- give insight (though not a complete understanding) on how life arose on Earth, and robotic spacecraft are actively searching for life elsewhere in our Solar System.

TThe results from studies on Earth, the Solar System, and exoplanets across the Galaxy together indicate that the conditions for life are widespread in the Universe; extraterrestrial life has not been found yet, but does not seem implausible. Interstellar space travel between habitable planets, by humans or other advanced beings, is exceedingly difficult but not physically impossible. The course is thus rooted in modern science, but is connected to the long-standing philosophical question: Are we alone in the Universe? In the past, this question is often embedded in science fiction (such as movies about aliens) and discussion about whether aliens have visited Earth. Today, astronomical studies are leading the way in answering parts of the question with a strong scientific foundation. But there is no evidence yet for life outside of Earth.

Student activities and responsibilities

Part of the course resembles a traditional classroom learning environment: We have lectures by the instructor (online rather than in person), read chapters of our textbook, and take quizzes to evaluate that we have learned the material. But the course also has more (inter)active assignments: students participate in discussion forums; take part in a huge citizen science research effort; and engage in science writing, producing two papers. The result is a multifaceted learning experience encouraging students to engage in active learning processes. At Penn State, a credit represents about 45 hours of work, which implies 9 hours-per-week during the 15-week semester. It is not a trivial commitment. Student responsibilities are distributed throughout the semester and the course cannot be completed in a rush.

Having no face-to-face classes in a World Campus class has the disadvantage that we never meet as a learning community, but it also has advantages. Students need not reside or travel to the Penn State campus; they can live anywhere in the world. Students do not have to attend class at specific times; all interactions are asynchronous. This is very convenient for individuals with other important responsibilities. But the independence provided by World Campus does mean that students must be disciplined in devoting time to the course continuously during the semester. Duties include: studying course material (on-line lectures, linked on-line material, textbook reading), taking timed quizzes (which must be taken within specified 4-day intervals), writing two short research papers (with specified deadlines), participating in interactive discussions and a major on-line activity. Details of the student responsibilities appear below under Graded Activities.

Course Outline

The course is divided into five themes that are, in turn, divided into several topics. The course is designed as a 15-week course with a new Web page environment for each week. Readings from our textbook, An Introduction to Astrobiology (abbreviated AIA) associated with each week are listed. Note that Thanksgiving Holiday takes place between Weeks 13 and 14.

Theme I: Astronomical context for life (Weeks 1-2)
1. Cosmology: The history of the Universe
2. Stars: Energy for life

Theme II: Life on Earth (Weeks 3-4)
3. Biochemistry & origin of life on Earth [AIA Chpt 1]
4. Early life & Earth's atmosphere [AIA Chpt 2]

Theme III: Life elsewhere in the Solar System (Weeks 5-7)
5. Review of our Solar System
6. Possibility of life on Mars [AIA Chpt 3]
7. Possibilities of life in the outer Solar System [AIA Chpts 4-5]

Theme IV: Planetary systems in the galaxy (Weeks 8-11)
8. Discovering exoplanets [AIA Chpt 6]
9-10. Census and properties of exoplanets [AIA Chpt 7]
11. Formation of planetary systems

Theme V: Life around other stars (Weeks 12-15)
12. Possibilities of life in other planetary systems [AIA Chpts 2 & 8]
13-14. Searching for extraterrestrial life [AIA Chpt 9]
15. Philosophical perspectives

Graded activities

40% Quizzes After each Theme, students will take a quiz on recent material covered in the class, associated reading and online material. The quizzes have combinations of multiple choice, short answer and short essay questions. Students may have access to notes, the textbook, and the Web, but study prior to the quiz is necessary because of the time constraint. Each quiz will be taken in Penn State's Canvas Web environment in a single sitting anytime over a 4-day period starting early-Friday and ending end-of-Monday. Dates are: Quiz #1 (Sep 3-6), Quiz #2 (Sep 17-20), Quiz #3 (Oct 8-11), Quiz #4 (Nov 5-8), Quiz #5 (Dec 10-13). For each student, the lowest scoring quiz is dropped and each remaining quizzes is worth 10% of the course grade.

30% Papers Students will submit two original papers using topics and resources provided by the instructor. The goals are: (1) investigating a narrow scientific issue in some detail; (2) assimilating diverse information into a coherent narrative; and (3) training in the art of scientific writing. The papers review scientific findings and present them in a formal style. Papers have 3 pages single-spaced of text supplemented by references and figures. The student learns how to write high-quality scientific documents from background material benefiting from individual interaction with the instructor on Paper #1. The student then writes Paper #2 on their own. There are three deadlines: preliminary draft of Paper 1 (outline + 2 paragraphs, 3% of grade, due Monday Oct 4), final version of Paper 1 (12%, Monday Oct 18), and delivery of Paper 2 (15%, Monday Nov 15). More details about science writing, paper requirements, and sample topics

20% Discussion Throughout the course, we will hold informal discussions on through the Canvas Discussion environment. The instructor will start with a question, often accompanied with on-line material. Students then participate with with commentary and interaction based on scientific fact and reasoning. Points are earned by number and quality of contributions with a maximum of 20% of the course grade.

10% Project During Weeks 8-10, we will engage in the Zooniverse Citizens Science' activity Planet Hunters TESS (Links to an external site.) based on NASA's Transiting Exoplanet Survey Satellite launched in 2018. After Web-guided training, each student will examine a different subset of TESS's star 'light curves', looking for the characteristics repeated dips in brightness that occur when an exoplanet passes in front of the star. Students will submit a document of their effort and analysis, and the class's collective contribution will be discussed.

Student's final letter grades for the course (A/A-/B+/B/B-/C+/C/D/F) will be based on the points earned through the above assignments. A rough conversion for the course scores is: A 90-100%, B 80-90%, C 65-80%, D 50-65%, F <50%. But the final conversion will be adjusted based on the instructor's judgment of class performance. Throughout the semester, each student can access their scores on the Canvas grade book, and consult with the instructor on their progress.

Academic integrity and other issues

All Penn State and College of Science policies regarding ethics and honorable behavior apply to this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing published material or work of others, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used, or tampering with the academic work of other students. In particular, software will be used to detect possible plagiarism on the papers. Quizzes will be 'open book' and 'open notes' and there will be no proctoring during the quizzes.

Students enrolled at Penn State are expected to act with civility and personal integrity; respect other students' dignity, rights, and property; and help create an environment in which all can succeed through the fruits of their own efforts. Students should familiarize themselves the Eberly College of Science Code of Mutual Respect and Cooperation. Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability,

gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity via the Report Bias webpage.

Penn State welcomes students with disabilities. Students needing accommodation should see the Student Disability Resources Web page, obtain an appropriate letter from the disabilities services office, and consult with the instructor early in the semester.

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. Resources include the Counseling and Psychological Services (CAPS) at University Park campus, Penn State Crisis Line (24 hours/7 days, 877-229-6400), and Crisis Text Line (24 hours/7 days, text LIONS to 741741).