

PTYS 170A1 – Planet Earth: Evolution of a Habitable World

Tier-One General Education Course

Kuiper Space Sciences Rm 308 Tues/Thurs 2:00-3:15 pm

Instructor: Dr. Lynn Carter, lmcarter@lpl.arizona.edu

Office Hours: Tuesdays 11-noon and Wednesdays 11:00-noon and (or by appointment), 533A Kuiper Space Sciences Building

Teaching Assistants:

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Office Hours: Kuiper 334, Thursday 9:30-10:30 and Friday 11:00-noon

Course website: This course will use a D2L website for assignments, lecture notes, and some communications. Homework and the final project will be submitted through the website so it is important to be able to access the site frequently.

Course Objectives:

This course develops a planetary science perspective on the evolutionary processes that shaped Earth through its history. We will examine what makes Earth habitable, and we will discuss the influences that physical, chemical and biological systems can have on each other. We will explore some of the other potentially-habitable worlds in our Solar System and investigate what factors contribute to habitability. And we will discuss how Earth's climate has changed in the past and how humans are changing the climate today. Habitability and the search for life in the universe are exciting research fields today, and this course will expose students to this interdisciplinary field, including discussion of current and future spacecraft missions and exoplanet studies.

During the course, the students are expected to learn:

- What do we mean by habitability? How do we assess whether a planet is habitable?
- What physical and chemical processes lead to habitability? What does life require to survive?
- Basics of how the Solar System and Earth evolved, including the origin of the Sun and Moon, changing of Earth's atmosphere through time, and plate tectonics
- How life originated on Earth
- Some techniques that we use to study Earth and other planets
- How Earth's climate changed in the past and how it will change in the future
- How and where we search for habitable environments in our Solar System and beyond
- What we can learn about habitability by studying our nearest neighbor planets Venus and Mars as well as the outer Solar System icy moons
- What factors make Earth unique in our Solar System, and how could things have turned out differently

Required Texts and Materials:

- The course textbook is “Earth: Evolution of a Habitable World” by Jonathan Lunine.
- You will also need a Turning Point clicker, and will need to register it in D2L.

The textbook provides text and figures that can help you study, understand and review course material. Some material presented in lectures is not in the textbook. For these lectures, the lecture notes will contain a slide with additional reading, available in university libraries, for students that would like additional information.

Information about registering your clicker can be found at <http://help.d2l.arizona.edu/student/turning-techclickers-overview>

Course Communications:

Communications will primarily be done with in-class announcements, and to a lesser extent through the course D2L website. Coming to class is the best way to receive information about the exams, final project, schedule etc. Homework and exams will also be returned in class.

Lectures and Class Participation:

Most lectures will be presented by Dr. Carter, although occasionally a guest lecturer may lead the class. The lectures will be placed on D2L before the class so they can be downloaded in advance. Some students like to use the course notes as study guides, other students like to bring a copy to class and annotate them during the lecture. Lectures will include participation in the form of questions, class discussion, demonstrations, and/or short writing assignments.

The lectures will use Turning Technology clickers for in-class participation responses. The purpose of these in class clicker questions is to encourage students to think about and use the course material. The in-class questions will provide practice for exam-type questions, sort of like an exam review session during normal class. Correct answers are not required for in-class work, but your participation will be recorded and will comprise part of the final grade, so it is important that you bring your clicker to class each day. This grade component reflects your efforts in coming to class and proactively thinking about the course material. The Code of Academic Integrity applies to clickers as well – people caught using multiple clickers to record answers for their friends may receive a zero for this grade component.

Writing Requirement:

This is a Tier-One General Education course, and has a requirement of at least 10 pages of writing. Over the course of the semester, this writing will be distributed among homework, in-class writing, and the term project.

Homework:

There will be 6 homework assignments throughout the semester, and they will be posted in advance on the D2L website. The homework will be a combination of multiple choice, written short response and short essay. Each homework will have at least one week for completion, then they will be graded over the next week and returned to you. Homework must be turned in

as a paper copy in class, as well as on D2L, where it will automatically be checked for plagiarism. You may discuss the homework with other students, but be sure the final work is yours. Do not let others copy your homework; it could result in your getting flagged for plagiarism!

Exams:

There will be three exams, all cumulative. The exams will cover all aspects of the course: lectures, in-class questions, and homework. The dates of the exams are listed below, so check now to see if you might have an approved conflict! Exhibiting suspicious behavior during an exam may result in confiscation of your exam and/or a zero grade. No cellphones, laptops, or notes are allowed. You will not need a calculator. There will be no final exam in the course as all the exams are cumulative.

Final Project:

This course will have a final writing project that will involve researching material relating to the course and applying this information with what you learned in the course to produce a research paper. There will be three possible projects for you to choose from, all of which will require a 5-page written report. You are encouraged to start on this early, and a draft copy may be turned in to receive comments and allow a revision before final grading. The final project will also be turned in as a paper copy in class, and on D2L, and will be checked for plagiarism.

Course schedule/Due Dates:

The course schedule is listed below. The particular lecture topics are subject to change (though any changes are expected to be minor), but the exam, homework and project due dates are fixed. Check now to see if you have any conflicts!

Lec	Date	Topic	Due in class	Textbook Readings
1	Tu Aug. 22	Course Introduction and Our Solar System		
Part 1: Origins and Earth's early history				
2	Th Aug. 24	First step in building a Solar System: The origin of our Sun and other stars		Sections 10.1-10.3
3	Tu Aug. 29	Types of stars and how they generate energy and elements		Chapter 4
4	Th Aug. 31	Powering the Solar System: Light and Energy		Section 3.4
5	Tu Sep. 5	Gravity and the birth of planets	Hmwk 1 due	Section 11.1-11.6
6	Th Sep. 7	Early evolution of the Solar System and defining the Habitable Zone		Sections 10.1-10.3

7	Tu Sep. 12	Creation of our Moon	Hmwk 1 returned	Section 11.7, 16.1
8	Th Sep. 14	Studying early Earth: Measuring ages of rocks and isotope ratios	Hmwk 2 due	Chapters 5 and 6
9	Tu Sep. 19	Relative age dating, rock stratigraphy, fossils and the geologic time scale		Chapter 8, (with some Chapter 7)
10	Th Sep. 21	The Hadean Earth – early crust and atmosphere	Hmwk 2 returned	Section 11.8-11.10
11	Tu Sep. 26	Exam 1 – in class Rm 308		
Part 2: The origin and evolution of life on Earth				
12	Th Sep. 28	Origin of Life: Definition of life and the need for energy		Chapter 12
13	Tu Oct. 3	Origin of Life: Cells, reproduction and the raw materials of life		Chapter 13
14	Th Oct. 5	The greenhouse effect and the faint young sun problem	Hmwk 3 due	Section 14.3-14.4
15	Tu Oct. 10	Earth in the Archean and the carbon-silicate cycle		Chapter 14
16	Th Oct. 12	Into the Proterozoic: the formation of continents	Hmwk 3 returned	Chapter 16
17	Tu Oct. 17	Plate tectonics	Hmwk 4 due	Chapter 9
18	Th Oct. 19	The oxygen revolution: Life sets Earth on a new course		Chapter 17
19	Tu Oct. 24	Searching for the earliest records of life on Earth	Hmwk 4 returned	
20	Th Oct. 26	Exam 2 – in class Rm 308		
Part 3: Earth's modern climate and the search for life elsewhere				
21	Tu Oct. 31	The Phanerozoic Earth and mass extinctions		Chapter 18
22	Th Nov. 2	Climate change and its causes in the Phanerozoic		Chapter 19
23	Tu Nov. 7	Human induced climate change: evidence for rapid warming	Hmwk 5 due	Chapter 21/22
24	Th Nov. 9	Human induced climate change: predicted effects	Final project draft due	Chapter 22
25	Tu Nov. 14	Venus: Why did Earth's sister planet turn out so different?	Hmwk 5 returned	Chapter 15

26	Th Nov. 16	Mars: Early Habitability?	Final project draft returned	Chapter 15
27	Tu Nov. 21	Ocean Worlds: Could there be life on icy moons?	Hmwk 6 due	Section 12.6
Thanksgiving Break!				
28	Tu Nov. 28	Exoplanets and the search for other Earths	Final project due, Hmwk 6 returned	Section 10.4
29	Th Nov. 30	Is Life Rare?		
30	Tu Dec. 5	Exam 3 – in class Rm 308	Final project returned after exam turned in.	

Grading Scale and Policies:

The course components will have the following weights:

3 Exams:	3x20% = 60%
Homework:	15%
Final project	20%
<u>In-class activities</u>	<u>5%</u>
Total	100%

Final letter grades will be assigned as follows:

- A: 90% or higher
- B: 80 – 89%
- C: 70 – 79%
- D: 55 – 69%
- E: Below 55%

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.

We reserve the right to scale the grades upwards, but there is no guarantee that this will be done.

Extra credit opportunities may also be provided. These will be worth at most 5% of the grade, and will be fairly challenging and/or require extra time. The extra credit should not be seen as a potential substitute for the regular course work.

Late Homework/Missed Exams:

No late homework will be accepted (except in very exceptional cases). For scheduled absences like religious holidays and university travel, the homework can be downloaded from D2L in advance so that it can be turned in early, and there is no reason for a due-date extension. In rare cases of a sudden family or medical emergency, late homework may be accepted with documentation, but only before the graded homework is returned.

If you need to miss an exam for a University-approved reason, contact Dr. Carter as soon as possible. If you know that you will need to be absent or will miss course deadlines, you are expected to make every effort to inform us before it occurs so that we can make arrangements in advance. Note that illness will require documentation as described in the Absence and Class Participation Policy below. Makeup exams may take a different format and have different questions than the in-class exam, so please make every effort to be present. Skipping the exam without a University-approved excuse or proper documentation of your absence will result in a zero grade.

Regrades:

All your work will be graded by a teaching assistant or by Dr. Carter. Although we will make every effort to evaluate your work thoroughly and fairly, we are only human. If you think there is an error in grading your homework, please contact the TAs first. If you have a question about an exam or final project grade, or cannot resolve a homework grade with the TAs, please contact Dr. Carter. We will look at your work again and return it to you with a written response, usually within a week. *You must report any grading errors within a week of the return of your assignment/exam to receive a regrade!*

Questions/Concerns:

It is very important that you let the instructor and/or TAs know your concerns about any aspect of the class as soon as they arise. There are many ways to contact us about questions or concerns about the course material and your grade. Weekly office hours are the best place to ask questions (about anything!) and get help. Your time in office hours will be best spent if you come prepared with specific questions and have looked at the homework in advance. Some students find it useful to write questions in a notebook before coming, to be sure everything gets answered. You are also welcome to talk to me after class, or make an appointment to meet with me or the TAs outside of office hours if that works better with your schedule.

We will also respond to emails. *Please use your university email and include PTYS 170A1 in the subject line so that we will recognize you as a student. Be sure to include your name.* Neither the instructor nor the TAs check email constantly, so please be patient waiting for a response. We will do our best to respond within a day.

My phone number is on the department website, but email is a better way to reach me. I have a lot of spacecraft mission teleconferences, so my phone is often busy for hours at a time. Plus, like many people nowadays, I almost never check my voicemail. Please email me instead of

calling. We can always set up a time for a phone call by email; that will guarantee I'm in my office to receive your call.

If you feel shy about saying or asking something in person, we will also have a suggestion box that can be anonymous. I will do my best to address any constructive comments about the course and lectures, and will try to make time to explain any science questions that are dropped in there. You can ask about any of the course material by dropping a note in the suggestion box, without having to raise your hand in front of everyone. Also feel free to put amusing space cartoons or other interesting astronomy related things in the suggestion box; I may show them in class!

Special Materials:

No special materials are required for this class. Only the textbook and clicker, described on page 2, are needed.

Makeup Policy for students who register late:

Students who register by the end of the second week of class may be given an opportunity to make up missed assignments within a reasonable amount of time, to be mutually agreed upon by the student and instructor.

Honors Credit:

Students wishing to contract this course for Honors Credit should email Dr. Carter to set up an appointment to discuss the terms of the contract. Information on Honors Contracts can be found at <https://www.honors.arizona.edu/honors-contracts>.

Absence and Class Participation Policy:

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is encouraged at all lectures, and in-class activities will be a small part of the final grade. *Students who miss in-class participation credits, homework/project due dates, or exams due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties.* Failure to submit third-party documentation will result in unexcused absences and/or a zero on the coursework.

- The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>.
- The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>
- Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Classroom behavior policy:

Department policy forbids any outside food or drink, except water, in the lecture hall. We all have a shared responsibility to create a positive learning environment free from distractions. If you arrive late to class or need to leave early, please choose a seat on the aisle and enter/exit quietly. Please silence your phone during class. If you need to accept an emergency phone call, exit the lecture hall fully before talking on the phone. Behaviors that could be disruptive to other students are not acceptable and disruptive students will be asked to leave. Examples of potentially disruptive behaviors include chatting, making phone calls, web surfing, watching movies, tv or video clips, live streaming or video recording, reading a newspaper.

Threatening Behavior Policy:

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

Accessibility and Accommodations:

Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit <http://drc.arizona.edu>.

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Code of Academic Integrity:

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>. Students who plagiarize will get a zero for the assignment, so if you have questions about plagiarism or how to cite sources, please talk to the TAs or instructor.

Please remember that when you turn in work, you are signing it with your name. This certifies that you are the author of the submitted work, and we will assume it is an expression of your original ideas. Unless a task is specifically designated as group-work (e.g. in-class group

participation), the coursework that is turned in must be yours, even if you have discussed the assignment with others. Class participation via clickers is also subject to this code – do not use your friend’s clicker to record answers for them or you may both receive a zero.

UA Nondiscrimination and Anti-Harassment Policy:

The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to ask questions and express well-formed opinions and their reasons for those opinions. We want to create a tolerant and open environment where comments and questions can be expressed without resorting to bullying or discrimination of others.

Confidentiality of Student Records:

All student records, including grades, will be handled according to FERPA guidelines. Please contact Dr. Carter yourself if you have questions about your grade.

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

Subject to Change Statement:

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.