

ATMOS/BIOL/GEO 1120 – Introduction to Earth System Science
Fall Semester 2024
T/Th, 10:45 AM – 12:05 PM; James Talmage Building (JTB) Room 140

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Office Hours: by appointment

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Instructor: Dr. Jonathan Wang (he/him)

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Office Hours: Mondays 10:00-10:45 AM

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Teaching Assistant: Meng Liu

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Office Hours: Thursday before class 10:00 – 10:45 AM*

Office Location: Aline W. Skaggs Biology Building (ASB), Room 502B

*email directly to schedule a meeting outside of the listed office hours

Required Materials

We assume you have access to a computer and the internet. If this is not the case, please let your instructors know ASAP. We will provide other resources as needed.

No textbook is required for the course. Reading and study materials will be provided or uploaded to Canvas by the instructors.

Course Description

Ice sheets are melting, biodiversity is being lost, and the climate is warming. An understanding of these processes and their relationship to imbalances in the components of the Earth system is fundamental for all people. The Earth system components, i.e. the atmosphere, the hydrosphere, the biosphere, and geosphere interact at various temporal and spatial scales and through positive and negative feedback mechanisms to determine the state of our planet. Major environmental issues such as global warming, ozone depletion and human threats to biodiversity indicate that the systems are out of balance. In this course, students will be introduced to the physical processes that underlie global change using a systems approach. Courses with similar titles at the university are at a level too advanced for first-year students, focus on one component of the Earth System (e.g. the solid Earth), or focus specifically on the effects of solutions to global warming.

This course will provide an interdisciplinary overview of the integrated Earth System. Case study investigations and an active classroom environment will equip students with the critical thinking skills to engage with modern environmental issues that span disciplinary boundaries and innovate on solutions.

Course Outcomes

By the end of this course, you will be able to:

1. Identify and explain the fundamentals of a “system”.
2. Describe the four spheres of the Earth System (atmosphere, biosphere, geosphere, and hydrosphere) and give examples of how each is interconnected.
3. Identify some of the key processes that shape the Earth system.
4. Differentiate processes that affect Earth’s surface over short time frames from those that affect Earth’s surface over much longer (i.e., geological) time frames.
5. Understand how and why Earth’s surface is changing, what actions humans are taking or plan to take in response to these changes, and their associated uncertainties.

This course satisfies the Life Sciences [LS] General Education requirements. This is a 3-credit course with no prerequisites.

Sustainability Course Attribute

This course fulfills the University of Utah requirements for the sustainability course attribute. Five UN Sustainable Development Goals, or SDGs (<https://sdgs.un.org/goals>), that will be explored in this course are:

- Goal 11: Sustainable Cities and Communities
- Goal 12: Responsible Consumption and Production
- Goal 13: Climate Action
- Goal 14: Life below water
- Goal 15: Life on land

Course Outcome 2 above is linked to SDGs 13 and 14. Safe and effective Climate Action (SDG 13) requires a holistic understanding of the Earth System, for example how the four individual Earth spheres interact. Life on Land (SDG 15) (and, for that matter, also Life Below Water – SDG 14) plays an integral role in these sphere-crossing interactions, for example by regulating global CO₂ production and consumption rates. Course Outcome 5 above is linked to SDGs 11, 12, and 13. Sustainable Cities (SDG 11) are a net goal of humanities response to climate change. Responsible Consumption and Production (SDG 12) is one viable path forward in this regard (and is also relevant to Course Outcome 4). We are now at the point that each of these efforts requires some form(s) of Climate Action (SDG 13).

Format and Weekly Schedule

Check Canvas for updates, but the general weekly plan is outlined below. All lecture slides and materials will be made available on Canvas prior to the beginning of class (whenever possible, at least the day before).

Tuesdays – Introductory lecture on the topic of the week (first ~50 minutes) followed by a supplementary discussion or activity (final ~30 minutes). Possible examples include: a classroom discussion about a recent news headline relevant to the week's topic; a classroom discussion about a science article relevant to the topic; or an activity geared toward applying the knowledge gained during the week. Discussions and activities will have an associated worksheet, due at the end of class. The weekly quiz will become available on Canvas on Tuesdays. You can take the quiz twice before the end of the week. Weekly quizzes are due by midnight on Fridays.

Thursdays – The background material introduced in Tuesday's lecture will be expanded upon in Thursday's lecture (first ~50 minutes). For example, what connects this topic to the other topics? More broadly, how is this topic relevant to a changing Earth? Lecture will once again be supplemented with a discussion or activity (final ~30 minutes).

Attendance, Participation, and Classroom Policies

This is an in-person class, and so your attendance is expected for every lecture. You are expected to arrive before the scheduled start of class and depart no earlier than the scheduled end of class (unless informed otherwise). Accommodations will be made on a case-by-case basis.

Each student is expected to be a contributing member to any in-class interactions. Food and drink policies will follow that of the host classroom. Electronic devices may be used during some classroom activities, but except for emergencies should be kept out of sight and placed on silent.

The most up-to-date information about the course will be made available on Canvas; when in doubt, check the Canvas page.

Assignments

Weekly quizzes – For each course week there will be an associated ~10 question weekly quiz. You are allowed two attempts. The higher of your two scores is your grade.

Activity worksheets – Discussions and activities will have an accompanying worksheet, to be completed and turned-in before the end of class. If you miss class on the day of an

activity, please download the activity sheet from Canvas, print and complete it, and return it to the instructor during the next scheduled lecture.

Systems Project – Each student chooses a modern climate or environment issue. For example, atmospheric pollution, wildfire, deforestation, glacier retreat, marine dead zones, eutrophication, sea level rise, ocean acidification, coral bleaching, human and hazardous wastes, microplastics, biodiversity loss, water use, toxic metals, agricultural land use, and desertification (among others). Each student then finds a news article that reports on a recent finding relevant to that issue. **The news article must reference a scientific journal article or dataset. In other words, the primary source of the finding.**

The project consists of five deliverables. On the due date for each deliverable, students will present to and grade their peers in small groups.

- 1) **Proposal (due 9/5/24)**. Introduce and describe your topic. Tell us why you chose this topic. Perhaps the issue has directly affected you, or perhaps you are simply really interested to learn more about it?
- 2) **News article (due 10/1/24)**. Find a news article relevant to your topic. This news article must reference at least one specific scientific paper or report. Summarize the article in your own words. Can you find a competing article that presents a different perspective? Tell us why you chose this article.
- 3) **Science source (due 10/24/24)**. Locate the scientific article behind the news article. Summarize the source of the findings in your own words. What information do the authors convey clearly? What is unclear or confusing? Include and explain at least one figure from the article.
- 4) **News-Science comparison (due 11/14/24)**. Now that you have read the news article and the scientific source of its topic in detail, is the former an accurate description of the latter? Why or why not?
- 5) **Earth system context (due 12/5/24)**. Using what you have learned in the course, describe how the finding being reported relates to the broader Earth system. For example, what is the primary sphere being investigated? How do the observed changes impact other Earth spheres? What are the relevant timescales of change?
- 6) ***EXTRA CREDIT* (due 11/25/24)**: the student creates and presents an artistic summary of their project at the end of the semester (e.g., artwork, a song, a video, a poem, anything else creative). Students may work in groups on this extra credit project if they so desire.

Final Exam – There is a final exam for this course. The exam will take place during finals week and will be administered on Canvas.

Grading Policy

Final grades will be weighted as follows:

Activity worksheets:	20%
Weekly quizzes	20%
Systems Project	40%
Final Exam	20%

Final grade percentages will be calculated at the end of the semester and rounded to the nearest whole number. Letter grades will be assigned using the following conversions: A = 93 – 100%; A- = 90 – 92%; B+ = 87 – 89%; B = 83 – 86%; B- = 80 – 82%; C+ = 77 – 79%; C = 73 – 76%; C- = 70 – 72%; D+ = 67 – 69%; D = 63 – 66%; D- = 60 – 62%; E = less than 60%.

Late policy: There will be a 10% deduction for each day late. After 1 week, late work will generally no longer be accepted, but please contact us as early as possible if you are struggling or if something unexpected arises.

Assessment: Quizzes are automatically graded on the course website. Assignments will be graded by rubric, provided in advance whenever possible. Instructors and TA will offer additional, personal feedback upon request.

Grade adjustments: Students requesting re-evaluation and potential adjustments to a score must describe how their answer is correct and why it should be re-evaluated. In doing so, the student must recognize that the entire submission may be re-evaluated, at the discretion of the instructor.

Course Schedule

(lead instructor in parentheses)

*systems project deliverable due; peer evaluation day

Week 1: Introduction to Earth System Science

8/20/24: Introduction to Earth Systems Science (Jon Wang)

8/22/24: The systems approach (Jon Wang)

Week 2: The Global Carbon Cycle

8/27/24: The global carbon cycle (Chadlin Ostrander)

8/29/24: A changing carbon cycle (Jon Wang)

Week 3: The global hydrologic cycle

9/3/24: The hydrologic cycle (Sara Warix)

9/5/24: The cryosphere (Chad Ostrander) *

Week 4: Great Salt Lake

9/10/24: A changing Great Salt Lake (Kevin Perry)

9/12/24: The Great Salt Lake Strike Team (John Lin)

Week 5: Hydrosphere

9/17/24: The ocean (Chad Ostrander)

9/19/24: A changing ocean (Chad Ostrander)

Week 6: Atmosphere

9/24/24: The atmosphere (Gannet Haller)

9/26/24: The greenhouse effect (Chad Ostrander)

Week 7: Biosphere

10/1/24: The biosphere (Jon Wang) *

10/3/24: Global biomes (Jon Wang)

Fall Break

Week 8: Geosphere

10/15/24: The geosphere (Chad Ostrander)

10/17/24: Earth's geological evolution (Chad Ostrander)

Week 9: Climate

10/22/24: Global warming & anthropogenic climate change (Gannet Haller)

10/24/24: Vegetation-atmosphere interactions (Jon Wang) *

Week 10: Biodiversity

10/29/24: Biodiversity and conservation biology (Jack Longino)

10/31/24: Biogeochemical evolution and mass extinctions (Chad Ostrander)

Week 11: Atmospheric Chemistry/Pollution

11/5/24: Ozone & the ozone hole (Jessica Haskins)

11/7/24: Acid Rain / EPA SO₂ regulations (Jessica Haskins)

Week 12: Ecosystem Disturbance

11/12/24: Wildfire and Land Use (Jon Wang)
11/14/24: Drought (Meng Liu) *

Week 13: Sustainability and Climate solutions

11/19/24: Carbon Offsets (Bill Anderegg)
11/21/24: Utah FORGE (Joe Moore)

Week 14: Systems Project and holiday

11/26/24: Systems project check in (Chad and Jon)
11/28/24: THANKSGIVING BREAK; no class

Week 15: Careers

12/3/24: Internships and networking (Laura Cleave)
12/5/24: Graduate Degrees (Meghan Dovick & Chad/Jon/Meng) *

Week 16: Final Exam

12/11/24: 10:30am-12:30pm on Canvas

Note: This syllabus is meant to serve as an outline and guide for our course. Please note that we may modify it with reasonable notice to you. We may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas.

University Policies

1. The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability & Access.

Given the nature of this course, attendance is required and adjustments will only be permitted as required by Policy 6-100(III)(O). If you need to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA). CDA will work with us to determine what, if any, ADA accommodations are reasonable and appropriate.

In compliance with ADA requirements, some students may need to record course content. Any recordings of course content are for personal use only, should not be shared, and should not be made publicly available. In addition, recordings should be destroyed at the conclusion of the course.

2. University Safety Statement. The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit <https://safeu.utah.edu>

3. Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 383 South University Street, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

- a. Lauren's Promise: Lauren's Promise is a vow that anyone – faculty, staff, students, parents, and community members – can take to indicate to others that they represent a safe haven for sharing incidents of sexual assault, domestic violence, or stalking. Anyone who makes Lauren's Promise vows to: 1.) listen to and believe those individuals who are being threatened or experiencing sexual assault, dating violence or stalking; 2.) represent a safe haven for sharing incidents of sexual assault, domestic violence, or stalking; and 3.) change campus culture that responds poorly to dating violence and stalking. By making Lauren's Promise, individuals are helping to change campus cultures that respond poorly to dating violence and stalking throughout the nation.

4. Academic Misconduct Statement. It is expected that students adhere to University of Utah policies regarding academic honesty, including but not limited to refraining from cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating. This includes the use of generative artificial intelligence (AI) tools without citation,

documentation, or authorization. Students are expected to adhere to the prescribed professional and ethical standards of the profession/discipline for which they are preparing. Any student who engages in academic dishonesty or who violates the professional and ethical standards for their profession/discipline may be subject to academic sanctions as per the University of Utah's Student Code: <https://regulations.utah.edu/academics/6-410.php>

5. Drop/Withdrawal Policies. Students may drop a course within the first two weeks of a given semester without any penalties. Students may officially withdraw (W) from a class or all classes after the drop deadline through the midpoint of a course. A "W" grade is recorded on the transcript and appropriate tuition/fees are assessed. The grade "W" is not used in calculating the student's GPA. For deadlines to withdraw from full-term, first, and second session classes, see the U's Academic Calendar.

6. Other important information to consider including:

- a. Student Code: <http://regulations.utah.edu/academics/6-400.php>
- b. Accommodation Policy (see Section Q): <http://regulations.utah.edu/academics/6-100.php>

7. Supports for Students. Your success at the University of Utah is important to all of us here! If you feel like you need extra support in academics, overcoming personal difficulties, or finding community, the U is here for you. Please refer to the Student Support Services page for the U for updated information.

8. Basic Needs Student Support Statement. Success at The University of Utah includes learning about and using available resources. The Basic Needs Collective (BNC) is a coordinated resource referral hub. They educate about and connect students to campus and community resources to help them meet their basic needs. As a central location for resource referrals related to food, housing, health insurance, managing finances, legal services, mental health, etc., any student experiencing difficulty with basic needs is encouraged to contact them. Drop into their office located in the Union basement or schedule with them online for an in-person or virtual visit through their webpage: <https://basicneeds.utah.edu/>.