

Term Information

Effective Term Autumn 2022

General Information

Course Bulletin Listing/Subject Area Geography
Fiscal Unit/Academic Org Geography - D0733
College/Academic Group Arts and Sciences
Level/Career Undergraduate
Course Number/Catalog 4911
Course Title Earth's Climate: Past and Future
Transcript Abbreviation Paleoclimate
Course Description This class will examine the Earth's climate and its natural development as understood from the geologic record spanning the full history of the planet, as well as how the future climate is likely to evolve under ongoing human modifications.
Semester Credit Hours/Units Fixed: 3

Offering Information

Length Of Course 14 Week, 12 Week, 8 Week, 7 Week, 6 Week
Flexibly Scheduled Course Never
Does any section of this course have a distance education component? No
Grading Basis Letter Grade
Repeatable No
Course Components Lecture
Grade Roster Component Lecture
Credit Available by Exam No
Admission Condition Course No
Off Campus Never
Campus of Offering Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites EARTHSC/HIST/EEOB 2911 or GEOG 3900/3901H
Exclusions
Electronically Enforced Yes

Cross-Listings

Cross-Listings EARTHSC 4911

Subject/CIP Code

Subject/CIP Code 40.0601
Subsidy Level Baccalaureate Course
Intended Rank Sophomore, Junior, Senior

Requirement/Elective Designation

Sustainability

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Providing a context to distinguish the natural Earth climate system as an integrated system of energy and biogeochemistry that humans can and do alter on different scales. At the end of this course, students should successfully be able to:
- Draw upon fundamental Earth system science concepts to describe how the evolution of earth's climate system relates to the evolution of planet/solar system.
- Draw upon fundamental Earth system science concepts to describe how the evolution of earth's climate system relates to the evolution of planet/solar system.
- Recall the fundamental radiation laws and apply them to the history of Earth's atmosphere to explain relative intensity of the greenhouse effect.
- Quantitatively describe the interactions of the short-term carbon cycle and anthropogenic sources of greenhouse gases.
- Critically evaluate the methods and limitations of using proxies to understand past climates over different spans of time.
- Students will be able to recognize spatial and temporal variations in climate patterns.
- Students will develop practical experience analyzing paleoclimate data time series.

Content Topic List

- Framework of Climate Science: Earth's Climate System Today, Climate Archives, Data, and Models
- Tectonic-Scale Climate Change: CO₂ and Long-Term Climate, Plate Tectonics and Long-Term Climate, From Greenhouse to Icehouse: The Last 50 Million Years
- Orbital-Scale Climate Change: Astronomical Control of Solar Radiation, Insolation Control of Monsoons
- Glacial/Deglacial Climate Change
- Historical and Future Climate Change

Sought Concurrence

No

Attachments

- EARTHSC-GEOG 4911 new course syllabus.pdf: Syllabus
(Syllabus. Owner: Grandey, Mary Allison)
- New EARTHSC-GEOG 4911 course rationale.docx: Course Rationale
(Cover Letter. Owner: Grandey, Mary Allison)
- GE Sustainability Theme - EARTHSC-GEOG 4911.pdf: Sustainability Theme Application
(Other Supporting Documentation. Owner: Grandey, Mary Allison)
- Copy of Curriculum-Map-Semesters_EARTHSC_GEOG4911_Submission DARLA.xlsx: Curriculum Map
(Other Supporting Documentation. Owner: Grandey, Mary Allison)

Comments

COURSE REQUEST
4911 - Status: PENDING

Last Updated: Munroe,Darla Karin
04/12/2022

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Grandey,Mary Allison	04/12/2022 12:01 PM	Submitted for Approval
Approved	Munroe,Darla Karin	04/12/2022 12:01 PM	Unit Approval
Pending Approval	Vankeerbergen,Bernadette Chantal	04/12/2022 12:01 PM	College Approval



SYLLABUS

GEOG/EARTHSC 4911

Earth's climate: Past and Future
Spring 2023 –Course # 4 911

COURSE OVERVIEW

Course information

- Class lecture periods: Tuesday, Thursday, [time].
- Credit hours: 3
- Prerequisites: either EARTHSC/HIST/EEOB 2911 or GEOG 3900/3901H
- Mode of delivery: in person

Instructors

Instructors:

Dr. Bryan G. Mark (address as Professor Mark)

- Email address: mark.9@osu.edu
- Phone number: 614-247-6180
- Office hours: T/R 11 a.m. -12 p.m. on zoom or by appointment

Dr. Matthew R. Saltzman

- Email address: saltzman.11@osu.edu
- Phone number: 614-292-0481
- Office hours: T/R 10 a.m. -11 a.m. on zoom or by appointment

GE Category Description & Goals

This class will examine Earth's climate and its natural development as understood from the geologic record spanning the full history of the planet, as well as how the future climate is likely to evolve under ongoing human modifications.

New GE Theme Goals & ELOs

This course may fulfill the following GE Theme:

Sustainability: GE Goal and Expected Learning Outcomes for Sustainability Theme courses:

GOALS: Successful Students will (1) analyze sustainability at a more advanced and in-depth level than in the foundations; (2) integrate approaches to sustainability by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or work they have done in previous classes and that they anticipate doing in the future; and (3) (specific to *Sustainability Theme*) analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, potential solutions across time.

EXPECTED LEARNING OUTCOMES: Successful students are able to: (1.1) engage in critical and logical thinking about sustainability; (1.2) engage in advanced, in-depth, scholarly exploration of sustainability; (2.1) Identify, describe and synthesize approaches or experiences as they apply to sustainability; (2.2) Demonstrate a developing sense of self as a learner through reflection, self-assessment and creative work, building on prior experiences to respond to new and challenging contexts; (3.1) (specific to *Sustainability Theme*) describe elements of the fundamental dependence of humans on Earth and environmental systems and on the resilience of these systems; (3.2) describe, analyze and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, currently, and in the future, and (3.3) devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.

This course fulfills the learning outcomes for the Sustainability Theme by:

Providing a context to distinguish the natural Earth climate system as an integrated system of energy and biogeochemistry that humans can and do alter on different scales. At the end of this course, students should successfully be able to:

- Draw upon fundamental Earth system science concepts to describe how the evolution of earth's climate system relates to the evolution of planet/solar system. *To address ELO 3.1 students will develop an advanced understanding of how chemical elements*

like carbon originate and are distributed throughout our planetary system, giving perspective on how they are essential for sustaining life, and are impacted by human activity.

- Apply the scientific method to evaluate how plate tectonics influences the long-term carbon cycle. *To address ELO 3.2 students will learn that volcanic activity emits carbon dioxide at a rate that is more than a factor of 10 less than humans, and therefore only human activity can explain the growth of carbon dioxide in Earth's atmosphere in the past century.*
- Recall the fundamental radiation laws and apply them to the history of Earth's atmosphere to explain relative intensity of the greenhouse effect. *By connecting the composition of Earth's atmosphere to radiative balance, students will conceptually link fundamental physics to the resilience of the Earth system, as moderated by humans. Emissions of greenhouse gases generated through human activity cause more energy to be retained, impacting sustainability now and into the future; technology could be applied to cool by radiation modification or carbon dioxide sequestration (ELOs 3.1, 3.2).*
- Quantitatively describe the interactions of the short-term carbon cycle and anthropogenic sources of greenhouse gases.
- Critically evaluate the methods and limitations of using proxies to understand past climates over different spans of time.
- Students will be able to recognize spatial and temporal variations in climate patterns
- Students will develop practical experience analyzing paleoclimate data time series. *To address ELO 3.3 students will devise informed and meaningful responses to problems and arguments in the area of sustainability by visually examining the carbon dioxide levels on Earth that occurred naturally in the past 800,000 years, which clearly delineates a period of perturbed and unabated increase in CO₂ that can be contrasted with the natural variability which was far less than current levels.*

HOW THIS COURSE WORKS

Class Format: This course will be delivered *in-person*, with all course materials accessible from OSU's **Carmen Canvas** interface.

Credit hours and work expectations: This is a **3-credit-hour course**. According to [Ohio State policy](#), students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) to receive a passing grade.

Attendance and participation requirements: Student attendance and participation will be tracked by use of TopHat, as well as completion of feedback and entrance/exit surveys. Students are expected therefore to be attentive regularly to the class Carmen page.

- **TopHat: RANDOM DURING LECTURES.** Regular assessment of understanding and participation will be evaluated and recorded via TopHat during lectures. We will count full credit for participating, but award additional extra credit for correct responses.
- **Group activities: PERIODIC.** There will be in-class activities that will require active participation and a single group grade. The final project grade will be modified to reflect individual participation effort, but active involvement is expected from all students.

COURSE MATERIALS

Textbook

We will use a **primary textbook** for the class. Required weekly readings will help organize our inquiry into global climate change AND provide good reference to basic principles. Because students can access used copies in different editions, it is listed as recommended with OSU Bookstore.

1. **Ruddiman, W.F., *Earth's Climate: Past and Future*.** MacMillan.

Other readings, media:

We will introduce other readings from news and scientific journals, as well as mixed media (video, podcasts). These will all be provided as pdfs or URL links via Assignments in Carmen, and linked to the weekly modules. One of the valuable resources in the class will be a repository of articles, web media, and more that will be archived in Carmen.

All other required articles, book sections, web paged, videos or podcasts are directly embedded in modules on Carmen (topics see course schedule).

CARMEN ACCESS

You will need to use [BuckeyePass](#) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](#) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the [Duo Mobile application](#) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

GRADING AND FACULTY RESPONSE

How your grade is calculated (% breakdown)

ASSIGNMENT CATEGORY	% POINTS
TopHat (quizzes and participation)	15
Climate connections (2 during semester)	10
Team Projects (abstract and presentation)	25
Midterm exam	25
Final exam	25
Total	100

Assignment descriptions:

Top Hat and Quizzes: At least one quiz will be given per lecture, based on material presented in lectures, readings, videos and other online material from the respective module. Note that some material from previous modules may also be on quizzes.

Climate connections (2): Students will be required to find relevant articles published in mainstream news media, and write a 1-page synthesis describing how the story relates to any topic discussed in class, and how paleoclimate approaches, data and/or methods are used. These short essays will include properly cited references to scholarly literature. For example, daily news articles are readily accessible through the New York Times climate portal and serves as a reputable source of news and information <https://www.nytimes.com/section/climate>. Two submissions are required and can be submitted any time before the last week of lectures. Submission is electronic and uploaded via Carmen.

Team project: The final project will include a group presentation. The groups will be assigned early in the class, and students will be interacting throughout the semester to select a topic and complete a multi-media presentation.

Description of Team Project Assignment

During 4th week, we will split up into groups of 3-4 students. Each group will need to decide on a class-related topic that interests them, on which they will give a 20 minute presentation during the last 2 classes of the semester. Once you decide on something (I would recommend choosing about ½ way through the semester), let us know what it is. The assignment will be to follow the development of thinking on the topic through the literature, describing the evolution of the idea. This will involve making liberal use of ISI or GEOREF searches: each pointade in the presentation needs to be backed up by a peer-reviewed citation. The project includes the following deliverables:

- Topic and science question: 8th week. Science questions need to address a single, specific question related to the course material. Calculations are not required, but literature must be consulted in formulating the question.
- Abstract: 11th week. A paragraph elaborating the science question, and describing the main conclusions needs to be emailed to both instructors. Thus, the conclusions of the project should be mostly finalized by this time.
- Presentations: last week. The science question, analysis of the literature, and conclusions should be clearly presented. Examples related to the question and your answers need to be presented. For the presentation, Powerpoints are encouraged, but only to show figures – no written words are allowed on slides (besides references or figure labels). This helps you learn what you are talking about; otherwise, it's easy to just recite words pulled from a paper. Each group member will need to contribute to equally to the presentation.

Exams: There will be a midterm and a final consisting of multiple choice and short answer essay questions.

Late assignments

Please refer to Carmen for due dates. Generally, modules will be completed by midnight on Monday night before new modules begin on Tuesdays (first class session of each week). Late assignments will be penalized by 10% per day late, and only accepted up to a maximum of 4 days late. If students anticipate having conflicts they are expected to discuss with instructors ahead of time.

Grading scale

93–100: A

90–92.9: A-

87–89.9: B+

83–86.9: B

80–82.9: B-

77–79.9: C+

73–76.9: C
 70 –72.9: C-
 67 –69.9: D+

60 –66.9: D
 Below 60: E

Instructor feedback and response time

We provide the following list to give you an idea of our intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

- **Grading and feedback:** For regular assignments, you can generally expect feedback within 10 days. Some exercises and papers will take longer to grade.
- **Email:** We will generally reply to emails and Carmen messages within **24 hours on days when class is in session at the university**. Please add "G3900" to the subject in your email to identify yourself; we teach multiple classes.
- **Discussion board:** We will check and reply to messages in the Carmen discussion boards regularly.

OTHER COURSE POLICIES

Academic integrity policy

POLICIES FOR THIS COURSE

- **Quizzes and exams:** You must complete the TopHat quizzes and the exams by yourself, without external help or communication from the internet or other people.
- **Written assignments:** Your written assignments should be your own original work. In formal assignments, you should follow a consistent citation style (e.g. MLA, APA, or AGU) to cite the ideas and words of your research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in—but no one else should revise or rewrite your work.
- **Reusing past work:** In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with us.
- **Falsifying research or results:** All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.
- **Collaboration and informal peer-review:** The course includes opportunities for formal collaboration with your classmates. While study groups and peer-review of major written

projects is encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

- **Group projects:** This course includes group projects, which can be stressful for students when it comes to dividing work, taking credit, and receiving grades and feedback. We have attempted to make the guidelines for group work as clear as possible for each activity and assignment, but please let us know if you have any questions.

OHIO STATE'S ACADEMIC INTEGRITY POLICY

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](#), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If we suspect that a student has committed academic misconduct in this course, we are obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact us.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- The Committee on Academic Misconduct web pages ([COAM Home](#))
- *Ten Suggestions for Preserving Academic Integrity* ([Ten Suggestions](#))

- *Eight Cardinal Rules of Academic Integrity* (www.northwestern.edu/uacc/8cards.htm)

Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options at titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you find yourself feeling isolated, anxious or overwhelmed, please know that there are resources to help: ccs.osu.edu. You can reach an on-call counselor when CCS is closed at (614) 292-5766 and 24 hour emergency help is also available through the 24/7 National Prevention Hotline at 1-(800)-273-TALK or at suicidepreventionlifeline.org. The Ohio State Wellness app is also a great resource available at go.osu.edu/wellnessapp.

COURSE SCHEDULE

See separate document that will be updated regularly on Carmen and labeled with current version date. Class content is subject to change, so students should download most current version. Changes will also be communicated using Announcements on Carmen.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let us know immediately so that we can privately discuss options. To establish reasonable accommodations, we may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** slds@osu.edu; 614-292-3307; 098 Baker Hall, 113 W. 12th Avenue.

WEEKLY SCHEDULE

Class Topics, Required Readings, and Exercises

*Note: These topics and readings are *subject to change*! Students will be advised of updates to the schedule on Carmen, and should follow the version with most current date.

Wk	Module-Part	Lecture topic	Date	Instructor	Text chapter
1	Part I Framework of Climate Science	1. Overview of climate science	T 1/12	Both	R1 (3-18)
		2. Earth's Climate System Today	R 1/14	Bryan	R2 (19-54)
2		3. Climate Archives, Data, and Models (1)	T 1/19	Bryan	R3 (55-68)
		4. Climate Archives, Data, and Models (2)	R 1/21	Matt	R3 (68-80)
3	Part II Tectonic- Scale Climate Change	5. CO2 and Long-Term Climate	T 1/26	Matt	R4 (81-96)
		6. Plate Tectonics and Long-Term Climate (1)	R 1/28	Matt	R5 (97-107)
4		7. Plate Tectonics and Long-Term Climate	T 2/02	Matt	R5 (108-120)
		8. Greenhouse climate	R 2/04	Matt	R6 (121-136)
5		9. From Greenhouse to Icehouse: The Last 50 Million Years (1)	T 2/09	Matt	R7 (137-142)
		10. From Greenhouse to Icehouse: The Last 50 Million Years (2)	R 2/11	Matt	R7 (143-155)
6	Part III Orbital-Scale Climate Change	11. Astronomical Control of Solar Radiation (1)	T 2/16	Matt	R8 (156-164)
		12. Astronomical Control of Solar Radiation (2)	R 2/18	Matt	R8 (165-176)
7		13. Insolation Control of Monsoons	T 2/23	Bryan	R9 (177-194)
		14. Insolation Control of Ice Sheets	R 2/25	Bryan	R10 (195-214)
8		15. Orbital-Scale Changes in Carbon Dioxide and Methane (1)	T 3/02	Matt	R11 (215-220)
		16. Orbital-Scale Changes in Carbon Dioxide and Methane (2)	R 3/04	Matt	R11 (221-232)
9		17. Orbital-Scale Interactions, Feedbacks, and Unsolved Mysteries	T 3/09	Bryan	R12 (233-250)
		MIDTERM EXAM	R 3/11		
10	SPRING BREAK		T 3/16		
			R 3/18		
11	Part IV Glacial/Degla cial Climate Change	19. The Last Glacial Maximum	T 3/23	Bryan	R13 (251-272)
		20. Climate During and Since the Last Deglaciation	R 3/25	Bryan	R14 (273-294)
12	Part V Historical and Future Climate Change	21. Millennial Oscillations of Climate	T 3/30	Bryan	R15 (295-314)
		22. Humans and Preindustrial Climate	R 4/01	Bryan	R16 (315-334)
13		23. Climate Changes During the Last 1,000 Years	T 4/06	Bryan	R17 (335-356)
		24. Climatic Changes Since 1850	R 4/08	Matt	R18 (357-374)
14		25. Causes of Warming over the Last 125 Years	T 4/13	Matt	R19 (375-392)
		26. Future Climatic Change	R 4/15	Bryan	R20 (393-409)
15		Group presentations	T 4/20		
			R 4/22		

New Course Proposal: EARTHSC/GEOG 4911 Earth's Climate: Past and Future

Matthew Saltzman (SES) and Bryan Mark (GEOG)

Rationale for a new course

There are currently two GE courses at Ohio State focused entirely on the subject of climate change, EARTHSC/EEOB/HIST 2911 (Climate Change: Mechanisms, Impacts, and Mitigation) and GEOG 3900/3901 (Global Climate Change: Causes and Consequences). These courses teach the subject matter at an introductory level and emphasize breadth in the material. The rationale for a new advanced, team-taught interdisciplinary course in Climate Change is to allow students to pursue in depth the area of climate science, including a more detailed knowledge and understanding of past and future climates. The proposed 4000-level course in 'Earth's Climate: Past and Future' will have a prerequisite of either EARTHSC/EEOB/HIST 2911 or GEOG 3900/3901. This new course will be team-taught by Earth Sciences and Geography, bringing together two departments with a history of collaboration in the areas of climate change and climate science, in part through interactions at the Byrd Polar and Climate Research Center (i.e. the ice core paleoclimatology team comprises Distinguished Geography Professor Ellen Mosley-Thompson in partnership with Distinguished SES Professor Lonnie Thompson). New skills and training will include project-based learning focused on the global effort to keep climate warming to below 2 degrees Celsius.

Course Description

Building on fundamentals of global climate change (covered in course prerequisites, either GEOG 3900 or ES/HIST/EEOB 2911), this class will examine Earth's climate and its natural development as understood from the geologic record spanning the full history of the planet. This requires a deeper and more comprehensive knowledge of the Earth system and the mechanisms that force climate change – its tectonic cycles, the evolution of the sun, ocean and atmosphere, the planetary energy balance and biogeochemical cycles. Only by appreciating the full range of natural variability of Earth's climate can we fully grasp the ways in which human activity now dominates the changes to climate and will continue to do so in response to societal choices in the future. Grappling with the consequences of climate change invokes broader political and economic dimensions related to development and energy conversion technology.

This new course is aimed at advanced undergraduates and will be team taught in Earth Sciences and Geography. The class is open to all majors having completed a prerequisite class in climate change. We will examine the key evidence of climate change and learn directly from climate researchers how they conduct their science. In addition, we will study links between climate and society's energy demands, sources and usage. By the end of the class, students will be more energy literate, and able to critically evaluate divergent facts about climate presented in media sources.

Similar courses to the proposed new course at the 4000- or 5000- level include Soils and Climate Change (ENR 5268), Measurement and Modeling of Climate Change, the Atmospheric Boundary Layer and Ecosystem Fluxes (ENVENG 5218), Weather, Climate and Global warming (GEOG 5900), Climate Change and Human Health (PUBHEHS 5320). We will address a critical gap in paleoclimatology accessible to undergraduates that will allow students to explore in depth the divers and processes of Earth's natural climate history that are the basis for assessing

the relative magnitude of future climates, their relationship to human activity, and their full ecological implications.

Anticipated demand and enrollment: We anticipate initial enrollment to be modest, about 15-20 students per year. Growth will be facilitated with outreach to the relevant populations in both Earth Sciences and Geography, as well as students in related disciplines, including Environmental Engineering, Environmental Science, and EEDS. The Undergraduate Studies Committees in both Earth Sciences and Geography will advertise the course during student visit days and communicate the opportunity to advisors. As the course is aimed at the Sustainability Theme and is also part of a new Certificate we are proposing, we anticipate that this course can be quite popular. Specifically, in our new Certificate this course we are proposing on Earth's Climate will fill an important need for students seeking an advanced course in Climate System Science, which includes a component of understanding the natural Earth system in order to appreciate the human influence on the natural system.

GE THEME COURSES

Overview

Courses that are accepted into the General Education (GE) Themes must meet two sets of Expected Learning Outcomes (ELOs): those common for all GE Themes and one set specific to the content of the Theme. This form begins with the criteria common to all themes and has expandable sections relating to each specific theme.

A course may be accepted into more than one Theme if the ELOs for each theme are met. Courses seeking approval for multiple Themes will complete a submission document for each theme. Courses seeking approval as a 4-credit, Integrative Practices course need to complete a similar submission form for the chosen practice. It may be helpful to consult your Director of Undergraduate Studies or appropriate support staff person as you develop and submit your course.

Please enter text in the boxes to describe how your class will meet the ELOs of the Theme to which it applies. Please use language that is clear and concise and that colleagues outside of your discipline will be able to follow. You are encouraged to refer specifically to the syllabus submitted for the course, since the reviewers will also have that document. Because this document will be used in the course review and approval process, you should be as specific as possible, listing concrete activities, specific theories, names of scholars, titles of textbooks etc.

Course subject & number

General Expectations of All Themes

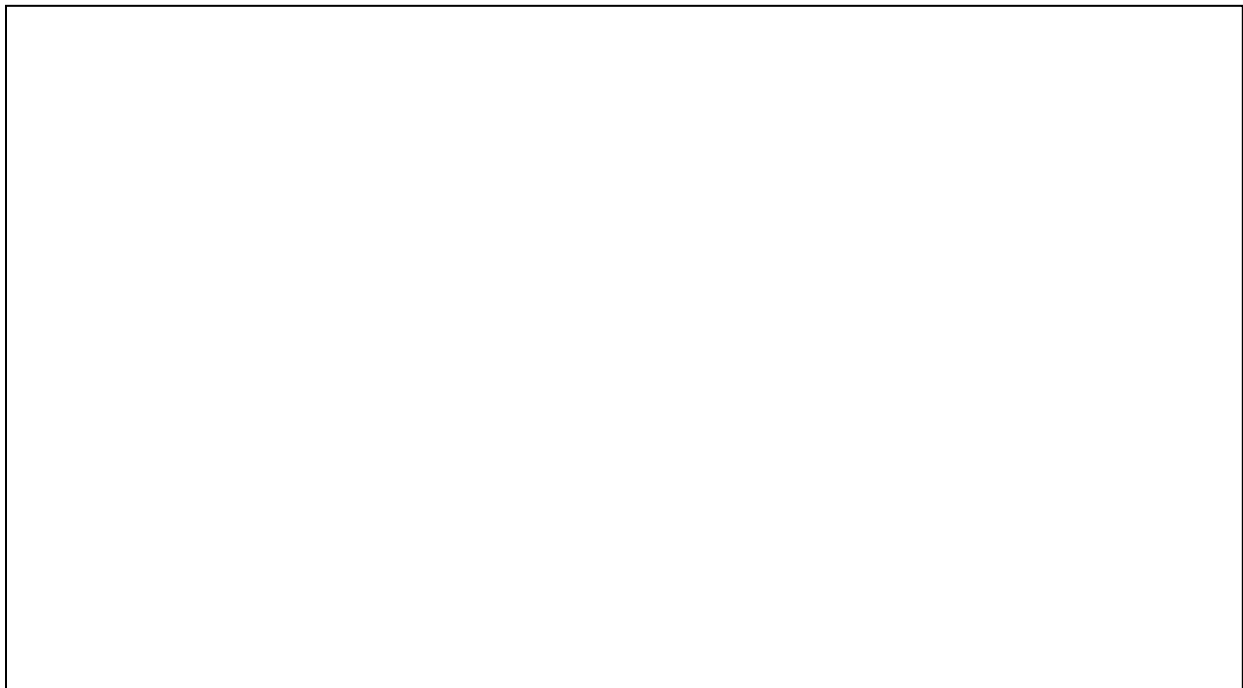
GOAL 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than the foundations.

Please briefly identify the ways in which this course represents an advanced study of the focal theme. In this context, “advanced” refers to courses that are e.g., synthetic, rely on research or cutting-edge findings, or deeply engage with the subject matter, among other possibilities. *(50-500 words)*

Course subject & number

ELO 1.1 Engage in critical and logical thinking about the topic or idea of the theme. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the topic or idea of the theme. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

A large, empty rectangular box with a thin black border, intended for the student to write their response to the ELOs. It occupies the lower half of the page.

Course subject & number

GOAL 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.

ELO 2.1 Identify, describe, and synthesize approaches or experiences as they apply to the theme.

Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.

Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

Course subject & number

Specific Expectations of Courses in Sustainability

GOAL 1: Students analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, potential solutions across time.

1.1 Describe elements of the fundamental dependence of humans on Earth and environmental systems and on the resilience of these systems. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

Course subject & number

1.2 Describe, analyze and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, currently, and in the future. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

1.3 Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)