## GEOSCIENCES (Div III)

### Chair: Professor Paul Karabinos

- Alex A. Apotsos, Lecturer in Geosciences
- Alice C. Bradley, Assistant Professor of Geosciences
- Phoebe A. Cohen, Professor of Geosciences
- José A. Constantine, Associate Dean for Institutional Diversity, Equity and Inclusion, Associate Professor of Geosciences; affiliated with: Institutional Diversity, Equity, and Inclusion, Geosciences
- Mea S. Cook, Professor of Geosciences; on leave Spring 2025
- Rónadh Cox, Edward Brust Professor of Geology and Mineralogy & Chair of Coastal and Ocean Studies; affiliated with: Geosciences, Coastal & Ocean Studies; on leave Spring 2025
- Chris Halsted, Visiting Assistant Professor of Geosciences
- Mike R. Hudak, Assistant Professor of Geosciences
- Paul M. Karabinos, Chair and Edna McConnell Clark Professor of Geology

**MAJOR**

The Geosciences major offers an understanding of the evolution of our planet and its interacting global systems. In this era of global change, geoscience provides the tools that can help us learn to live sustainably with our environment, and appreciate our place within the vastness of Earth history. Forces within the Earth create mountain ranges and ocean basins and drive the movements of continents. Wind, water and ice shape the surface of the Earth, making and changing the landscapes around us. Sedimentary rocks and the fossils within them teach us how life and climate have evolved over the vastness of time.

Geosciences graduates have a wide range of career options, both with and without graduate training. The many choices include environmental consulting, hazard assessment, hydrology, energy industries, outdoor education, working for geoscience and environment related government agencies and nonprofits, and research and teaching in universities, colleges, and secondary schools. Many students choose to double-major in fields as diverse as Art, Economics, History, Physics, Mathematics, English, and Philosophy, and often find jobs where they can apply the synergies of their Geosciences double major. No matter what field they enter, all our Geosciences graduates pursue their lives and careers with a deeper appreciation for the natural world around them.

The major is designed to provide a solid grounding in the geosciences while being adaptable enough to accommodate diverse paths driven by student interests. There are no required courses, but students work through the menu below, which allows a lot of scheduling flexibility.

If you have questions about the major, or how the different requirements apply to you, please contact the Geosciences Chair.

**Geosciences major requirements:**

The Geosciences major requires a minimum of nine courses, distributed by course level and topic group; each course can fulfill both a course level and topic group requirement. To complete the minimum nine courses, students can add electives at any level, as long as GEOS is the primary course prefix, and the total number of 100 level courses does not exceed two. In addition, students may count either GEOS 104 or GEOS 110 towards the major, but not both.

**Course Level Requirements:**

**At least one and at most two 100-level courses**:

GEOS 100 Introduction to Weather and Climate

GEOS 101 Co-Evolution of Earth and Life

GEOS 102 An Unfinished Planet

GEOS 103 Global Warming and Environmental Change

GEOS 104 Oceanography

GEOS 107 Astrobiology

GEOS 109 Geologic Hazards

GEOS 110 Oceans and Society

**At least two 200-level courses selected from this group**:

GEOS 201 Field Methods and Structural Geology

GEOS 207 The Geoscience of Epidemiology and Public Health

GEOS 208 The Modern Carbon Cycle: the Story from Stable Isotopes

GEOS 210 Oceanographic Processes (Williams Mystic course)

GEOS 212 Paleobiology

GEOS 214 Mastering GIS

GEOS 215 Climate Change

GEOS 217 Planets and Moons

GEOS 255 Environmental Observations

GEOS 275 Ocean and Climate Changes

**At least two 300-level courses selected from this group**:

GEOS 301 Geomorphology

GEOS 302 Sedimentology

GEOS 304 Mineralogy and Petrology

GEOS 309 Modern Climate

GEOS 327 Coastal Processes and Geomorphology

**At least one of the following 400-level courses**:

GEOS 401 Global Tectonics and the Rise of Mountains

GEOS 405 Geochemistry: Understanding Earth's Environment

GEOS 409 Volcanology

GEOS 410 The Cryosphere

GEOS 411 Geobiology

GEOS 414 Reading Deep Time

**Elective courses at all levels**

Geosciences majors can select from any of the previous courses in addition to the following elective courses to bring the total to number of Geosciences courses to nine:

GEOS 111T Radical Science- How Geology Changed the Way We See the World

GEOS 211T Rates and Dates: Calibrating the Rock Record

GEOS 220T Evolution of and on Volcanic Islands

GEOS 221T Examining Inconvenient Truths: Climate Science Meets U.S. Senate Politics

GEOS 227T Climate Data Analysis

GEOS 250T Climate, Tectonics, and Erosion

GEOS 280T Carbon Dioxide Uptake and Our Climate Future

GEOS 312T Mass Extinctions: Patterns and Processes

**Disciplinary Groupings**

Students must take one and *preferably two* courses from each of the following three groups:

**Climate and Oceans:**

GEOS 208 The Modern Carbon Cycle: The Story from Stable Isotopes

GEOS 210 Oceanographic Processes (only offered at Williams-Mystic)

GEOS 215 Climate Changes

GEOS 221T Examining Inconvenient Truths: Climate Science meets U.S. Senate Politics

GEOS 255 Environmental Observation

GEOS 227T Climate Data Analysis

GEOS 275 Ocean and Climate Changes

GEOS 280T Carbon Dioxide Uptake and Our Climate Future

GEOS 309 Modern Climate

GEOS 405 Geochemistry: Understanding Earth's Environment

GEOS 410 The Cryosphere

**Sediments and Life:**

GEOS 207 The Geoscience of Epidemiology and Public Health

GEOS 212 Paleobiology

GEOS 301 Geomorphology

GEOS 302 Sedimentology

GEOS 308 Life on Mars?

GEOS 312T Mass Extinctions: Patterns and Processes

GEOS 404/GEOS 327 Coastal Processes and Geomorphology

GEOS 411 Geobiology

GEOS 414 Reading Deep Time

**Solid Earth:**

GEOS 201 Field Methods and Structural Geology

GEOS 211T Rates and Dates: Calibrating the Rock Record

GEOS 205 Economic Geology and Earth Resources

GEOS 217 Planets and Moons

GEOS 220T Evolution of and on Volcanic Islands

GEOS 250T Climate, Tectonics, and Erosion

GEOS 304 Mineralogy and Petrology

GEOS 317 Current Topics in Planetary Geology

GEOS 401 Global Tectonics and the Rise of Mountains

GEOS 409 Volcanology

## PREPARATION FOR GRADUATE SCHOOL

Students planning to go to graduate school should be aware that most graduate programs will expect applicants to have a background in math/stats as well as a year or so of study in related sciences, in addition to the requirements of the Geosciences major. The selection of outside courses will depend on the field in which a student wants to specialize. Graduate programs in solid-earth geosciences commonly expect entering students to have taken courses in chemistry. For those going into environmental geosciences, courses in chemistry, computer science and/or statistics are recommended. For those considering geobiology programs, biology courses are important. For students entering planetary geology, physics is recommended. Students considering graduate work in geosciences should therefore consult with faculty to ensure that they plan wisely.

## THE DEGREE WITH HONORS IN GEOSCIENCES

The degree with honors in Geosciences provides students with an opportunity to undertake a year-long independent research project under the supervision of a faculty member, culminating in a thesis that demonstrates outstanding achievement of an original and innovative nature. In addition to the major requirements listed above, those who are candidates for the degree with honors take the following sequence in the Fall, Winter Study, and Spring of their senior year:

GEOS 493-031-494 Senior Research and Thesis

The principal considerations in admitting a student to the honors thesis program are interest and motivation, mastery of fundamental material and skills, and ability to pursue independent study diligently. Interested students should talk to Geosciences faculty about project options at any time, but generally no later than January of the Junior year.

## STUDY AWAY

Students planning to study off-campus should meet as early as possible with the Department Chair to plan and to discuss how potential courses

might be used in the major; note that the Chair cannot pre-approve abroad credit. Although many study-away programs do not offer geoscience courses, there are some that dovetail well with Geosciences. Examples include the Williams-Mystic program, the Frontiers Abroad program at Canterbury University in New Zealand, and the program at the University of Otago in New Zealand. Courses offered at Norwegian Technical Universities and at several universities in the United Kingdom have also been accepted. Up to two geoscience courses taken away from Williams can be counted toward the nine-course major. Be sure to meet with a Geosciences faculty advisor or Department Chair to discuss your plans and ideas for off-campus work.

## FAQ

Students MUST contact departments/programs BEFORE assuming study away credit will be granted toward the major or concentration.

**Can your department or program typically pre-approve courses for major/concentration credit?**

Generally not until after a student returns and can provide course material for review (e.g. Syllabus and/or completed work such as exams, portfolios, lab reports and the like).

**What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?**

Complete syllabus and course description, including readings, assignments, evaluation criteria.

**Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?**

Yes. A maximum of two courses can be credited toward major requirements.

**Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?**

No.

**Are there specific major requirements that cannot be fulfilled while on study away?**

No.

**Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)**

Students should consult with the chair or other department faculty members to plan ahead and make sure that requirements can be met. In general, only courses with a lab and/or field component may count towards core GEOS requirements, other courses may be counted as GEOS electives.

**Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn't.**

None to date.

**GEOS 100 (S) Introduction to Weather and Climate** (QFR)

**Cross-listings:** CAOS 100

Primary Cross-listing

How is it that we have such a hard time predicting if it's going to rain next week, but we can be confident in projections of future climate change decades from now? This course will explore how fundamental laws of physics determine why air moves and changes, creating the wind, clouds, precipitation, and extreme events that form our weather. Building off of our understanding of the atmosphere, we'll look at longer time scales to develop an understanding of earth's climate system, global heat and moisture transport, climate change, and the ways that humans can change our planet. We will use weather and climate models to learn how scientists and meteorologists predict future conditions. Labs include benchtop experiments, data analysis projects, and self-scheduled meteorological observations. This course is in the Oceans and Climate group for the Geosciences major.

**Requirements/Evaluation:** weekly problem sets, lab assignments, midterm exam, and final exam

**Prerequisites:** none

**Enrollment Limit:** 60

**Enrollment Preferences:** first year and second year students, Geosciences majors

**Expected Class Size:** 60

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 100(D3) CAOS 100(D3)

**Quantitative/Formal Reasoning Notes:** This course will have regular problem sets which require substantial quantitative reasoning. Labs will require analysis, presentation, and explanation of quantitative data, and exams will require some quantitative problem solving.

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses

Not offered current academic year

**GEOS 101 (S) The Co-Evolution of Earth and Life**

**Cross-listings:** ENVI 105

Primary Cross-listing

Our planet is about 4.6 billion years old and has supported life for at least the last 3.5 billion of those years. This course will examine the relationship between Earth and the life that inhabits it, starting with the first living organisms and progressing to the interaction of our own species with the Earth today. Students will investigate the dynamic nature of the Earth-life system and learn about the dramatic changes that have occurred throughout the history of our planet. We will ask questions such as: How did the Earth facilitate biologic evolution, and what effects did those biologic events have on the physical Earth? When did photosynthesis evolve and how did this biological event lead to profound changes in the world's oceans and atmospheres? How and why did animals evolve and what role did environmental change play in the radiation of animal life? How did the rise and spread of land plants affect world climate? How do plate tectonics, glaciation, and volcanism influence biodiversity and evolutionary innovation? What caused mass extinctions in the past and what can that teach us about our current extinction crisis? Labs will involve hands-on analysis of rocks, fossils, and real-world data as well as conceptual and analytical exercises; field trips will contextualize major events in Earth history and will help students learn to read the rock record. Through these investigations, the class will provide a comprehensive overview of Earth's dynamic history.

**Class Format:** one laboratory per week plus one all-day field trip

**Requirements/Evaluation:** lab assignments, weekly quizzes, and a final independent project

**Prerequisites:** none

**Enrollment Limit:** 30

**Enrollment Preferences:** first year and second year students, Geosciences majors

**Expected Class Size:** 30

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

ENVI 105(D3) GEOS 101(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses

Spring 2025

LEC Section: 01 TR 9:55 am - 11:10 am Phoebe A. Cohen

LAB Section: 02 T 1:00 pm - 3:00 pm Phoebe A. Cohen

LAB Section: 03 W 1:00 pm - 3:00 pm Phoebe A. Cohen

**GEOS 102 (S) An Unfinished Planet**

Earth is an evolving planet. The pace of plate tectonics may be imperceptibly slow but earthquakes and volcanic eruptions caused by shifting plates disrupt civilizations. In a geological time frame, nothing on Earth is permanent: ocean basins open and close, mountains rise and fall, continental masses collide and pull apart. There is a message here for all of us who live, for an infinitesimally brief time, on the moving surface of the globe. This course uses the plate tectonics model--one of the fundamental scientific accomplishments of the 20th century--to interpret the processes and products of a changing Earth. The emphasis will be on mountain systems (on land and beneath the oceans) as expressions of plate interactions. Specific topics include the rocks and structures of modern and ancient mountain belts, the patterns of global seismicity and volcanism, the nature of the Earth's interior, the changing configurations of continents and ocean basins through time, and, in some detail, the formation of the Appalachian Mountain system and the geological assembly of New England. Readings will be from a physical geology textbook and primary sources. This course is in the

Solid Earth group for the Geosciences major.

**Class Format:** lecture three hours per week and lab (two involving field work) two hours per week; one required all-day field trip on the last Monday of the semester to the Connecticut Valley and the highlands of western Massachusetts

**Requirements/Evaluation:** three hour-tests and weekly lab work

**Prerequisites:** none

**Enrollment Limit:** 40

**Enrollment Preferences:** first year and second year students, Geosciences majors

**Expected Class Size:** 40

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses

Spring 2025

LEC Section: 01 MWF 10:00 am - 10:50 am Paul M. Karabinos

LAB Section: 02 Cancelled

LAB Section: 03 W 1:00 pm - 3:00 pm Paul M. Karabinos

**GEOS 103 (F) Global Warming and Environmental Change**

**Cross-listings:** ENVI 103

Primary Cross-listing

Earth is the warmest it has been for at least five centuries, and the surface of our planet is responding. From extreme floods and drought to landslides and wildfires, the natural processes that shape Earth's surface are tied to temperature and precipitation. People are beginning to feel the impacts, but in different ways depending on where they call home. In this course, we will investigate how climate change is altering landscapes and the natural processes that support them, highlighting all the ways that people are being affected today. Ultimately, we will develop an understanding of the consequences of climate change that connects physical processes with geography. Specific topics include foundations of the Earth system, plate tectonics and the construction of landscapes, Earth materials, rivers and flooding, hillslope processes, coastal processes, and climate impacts on natural resources such as fresh water and soil. Labs will use local field sites and analytical exercises to evaluate recent cases that reflect an interaction of the landscape and climate. We will also visit and engage with Black communities and community leaders across New England who are grappling with the unjust distribution of resources to mitigate climate impacts and who have been disproportionate bearers of environmental risk.

**Requirements/Evaluation:** written reports from laboratories and readings, class participation, a midterm and final exam

**Prerequisites:** none

**Enrollment Limit:** 48

**Enrollment Preferences:** first year and second year students, Geosciences majors and Environmental Studies majors and concentrators

**Expected Class Size:** 48

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 103(D3) ENVI 103(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses

Not offered current academic year

**GEOS 104 (F) Oceanography**

**Cross-listings:** ENVI 104 / CAOS 104

Primary Cross-listing

The oceans cover three quarters of Earth's surface, yet oceanography as a modern science is relatively young: the first systematic explorations of the geology, biology, physics and chemistry of the oceans began in the late 19th century. This introduction to ocean science includes the creation and

destruction of ocean basins with plate tectonics; the source and transport of seafloor sediments and the archive of Earth history they contain; currents, tides, and waves; photosynthesis and the transfer of energy and matter in ocean food webs; the composition and origin of seawater, and how its chemistry traces biological, physical and geological processes; oceans and climate change; and human impacts.

**Class Format:** two 75-minute lecture/discussion meetings each week; 2-hour lab every second week; one all-day field trip to the Atlantic coast of New England.

**Requirements/Evaluation:** lab activities, homework, reading-comprehension quizzes, three tests

**Prerequisites:** none

**Enrollment Limit:** 48

**Enrollment Preferences:** first year and second year students, Geosciences majors, Maritime Studies concentrators

**Expected Class Size:** 48

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** This course and GEOS 110 Oceans and Society cannot both be taken for credit.

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

ENVI 104(D3) GEOS 104(D3) CAOS 104(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses

Fall 2024

LEC Section: 01 TR 9:55 am - 11:10 am Chris Halsted

LAB Section: 02 T 1:00 pm - 3:00 pm Chris Halsted

LAB Section: 03 W 1:00 pm - 3:00 pm Chris Halsted

**GEOS 109 (S) Geologic Hazards**

Dramatic geologic events like earthquakes, volcanic eruptions, and tsunamis can inflict devastating tolls on human life, infrastructure, and economies, as the recent earthquakes in Turkey, Syria, and Afghanistan have sadly demonstrated. These events loom large in our imagination because of this same destructive power. Pop culture is full of references to natural disasters. (Think Hollywood movies like Don't Look Up, San Andreas, or The Day After Tomorrow. Even South Park has a volcano.) Most of these portrayals are based on some tiny seed of established scientific idea or fact, but much of the (mis)information they present is inaccurate. This course seeks to set the record straight. We will develop a framework based on fundamental geologic principles to understand why the most potent natural hazards are concentrated at tectonic plate boundaries. Case studies from recent and historical events will be used to investigate both how volcanoes and earthquakes work and how cascading systems failures exacerbate the human impacts of these phenomena. Exploration of these topics will include lectures, hands-on activities, and weekly laboratory exercises. Occasional comparison to disaster movies will be used to separate fact from fiction. The course will culminate in a final creative or written project.

**Requirements/Evaluation:** weekly lab assignments, 2 midterms, final project

**Prerequisites:** none

**Enrollment Limit:** 48

**Enrollment Preferences:** first and second year students

**Expected Class Size:** 48

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3)

Not offered current academic year

**GEOS 110 (F) Oceans and Society**

**Cross-listings:** CAOS 110 / ENVI 109

Primary Cross-listing

Oceans impact society in many ways: they provide much of our protein, they hide untapped mineral wealth, their circulation regulates global climate, they transport and accumulate our plastic garbage, marine storms batter coastal infrastructure, and sea-level rise threatens communities. However,

despite the oceans' importance throughout history--for trade, as a source of food, and because of their unpredictable dangers--we know shockingly little about them. More than 6000 people have reached the summit of Everest, Earth's highest elevation; but only 22 have visited Challenger Deep, the deepest point below the ocean surface. We have mapped the surfaces of Mars and Venus in far more detail than the topography of Earth's ocean basins. New marine organisms are discovered regularly. And we still don't fully understand the complex details of how ocean and atmosphere work together as the planet's climate engine. In this course, you will examine ocean science themes with direct societal relevance that are also at the forefront of scientific investigation. Topics will be selected based on current events, but are likely to include deep sea mining, meridional overturning, sea level rise, atmospheric rivers, and aquaculture. By taking focused dives into a range of subjects you will learn about the evolution and operation of the ocean as a physical and geological system as well as investigating the intersections between ocean functions, climate change, and human societies. Exercises and discussions will foreground active learning. A field trip to the Atlantic coast will integrate experiential investigation of the intersection between coastal change, extreme weather, and communities. The aim is to have energised interdisciplinary discussions about topics of pressing societal relevance, to understand some of the fundamentals of ocean science, to develop expertise in gathering and distilling information by researching new topics, and thereby to improve critical and analytical thinking.

**Class Format:** Two 75-minute lecture/discussion meetings each week; 2-hour lab every second week; one all-day field trip to the Atlantic coast.

**Requirements/Evaluation:** Evaluation is based on engagement with in-class activities, six graded lab exercises, four short writing/research assignments, and a five-page term paper

**Prerequisites:** none

**Enrollment Limit:** 60

**Enrollment Preferences:** First year and second year students

**Expected Class Size:** 60

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** This course and GEOS 104 Oceanography cannot both be taken for credit.

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 110(D3) CAOS 110(D3) ENVI 109(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses MAST Interdepartmental Electives

Not offered current academic year

**GEOS 111 (F) Radical Science- How Geology Changed the Way We See the World** (WS)

Copernicus shocked Europe when he suggested that the Earth is not the center of the universe. Hutton and other geologists made an equally radical proposal more than two centuries later when they introduced the concept of deep time and argued that the Earth was much older than 6,000 years, as determined by biblical scholars. Several decades later, Darwin and Wallace shook the foundation of western philosophy once more when they proposed that organisms evolved. When geologists reinterpreted landscape features once attributed to the great flood as evidence for past continental glaciation, the concept of extreme climate change through time sprang to life. During the 20th century, the permanence of Earth's geography was challenged by the continental drift hypothesis, which was initially rejected for decades until it reemerged as plate tectonic theory. This tutorial explores how geologic breakthroughs challenged western views of humans as the center of creation living in a world with limited change. There will be weekly tutorial meetings with pairs of students, and students will alternate writing papers on assigned topics. This course is in the Solid Earth group for the Geosciences major.

**Requirements/Evaluation:** five 5-page papers and five oral critiques of partner's papers

**Prerequisites:** none

**Enrollment Limit:** 10

**Enrollment Preferences:** First year students then second year students

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3) (WS)

**Writing Skills Notes:** Students will write five 5-page papers and will receive peer and instructor feedback on how to improve their writing skills and formulate sound arguments.

Not offered current academic year

**GEOS 201 (F) Field Methods and Structural Geology** (WS)

Geologic history is preserved in rocks and it can be deciphered using fundamental principles such as superposition and cross-cutting relationships. Field observations are essential to understanding the rock record, and data and interpretations are encoded in geologic maps. This course introduces students to topographic and geologic maps, best practices for geologic field work, the field identification of common minerals and rocks, geologic contacts, and structures such as folds, and faults. Students will develop skills for presenting field data in papers, figures, and oral presentations. This course is in the Solid Earth group for the Geosciences major.

**Class Format:** lecture and discussion, three hours per week and laboratory, three hours per week

**Requirements/Evaluation:** short weekly writing assignments will form the basis for two 10-page papers based on field trips and a final independent project

**Prerequisites:** Any 100 level geosciences course or permission of instructor.

**Enrollment Limit:** 16

**Enrollment Preferences:** Geosciences majors or students with a strong interest in geosciences

**Expected Class Size:** 12

**Grading:** no pass/fail option, no fifth course option

**Materials/Lab Fee:** $15 for field supplies

**Distributions:** (D3) (WS)

**Writing Skills Notes:** There will be two 10-page papers, each based on four field trips. Students will submit short field descriptions and figures with captions after each field trip. The shorter assignments will be incorporated in two papers. Students will receive from the instructor timely comments on their writing skills, with suggestions for improvement.

**Attributes:** GEOS Group C Electives - Solid Earth

Fall 2024

LEC Section: 01 MWF 11:00 am - 12:15 pm Paul M. Karabinos

LAB Section: 02 M 1:00 pm - 4:00 pm Paul M. Karabinos

**GEOS 207 (S) The Geoscience of Epidemiology and Public Health** (DPE)

**Cross-listings:** ENVI 201

Primary Cross-listing

The Coronavirus pandemic has highlighted the many ways that diseases can be transmitted in the environment. As a society we are becoming aware of the many ways that geological processes and materials and influence human health, in ways both beneficial and dangerous. This course unites geoscience, biomedicine and public health approaches to address a wide range of environmental health problems. These include water-related illnesses (e.g. diarrhea, malaria); minerals and metals, both toxic (e.g. asbestos, arsenic) and essential (e.g. iodine); radioactive poisoning (e.g. radon gas); and the transport of pathogens by water and wind. In many cases, the environmental health problems disproportionately affect marginalised populations, contributing to greater disease and death among poor communities and populations of colour. We will examine the broad array of dynamic connections between human health and the natural world. We will discuss the social justice implications of a range of environmental health problems. And we will examine current research into how coronaviruses, such as the one causing COVID-19, are transported in the environment. This course is in the Sediments and Life group for the Geosciences Major.

**Requirements/Evaluation:** Evaluation will be based on short weekly writing assignments as well as an individual project and poster presentation.

**Prerequisites:** No prerequisites

**Enrollment Limit:** 34

**Enrollment Preferences:** Preference to first-years, sophomores, and prospective Geosciences majors

**Expected Class Size:** 30

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3) (DPE)

**This course is cross-listed and the prefixes carry the following divisional credit:**

ENVI 201(D3) GEOS 207(D3)

**Difference, Power, and Equity Notes:** Through a series of case studies, we will examine ways in which marginalised groups (whether due to poverty,

race, or ethnicity) are disproportionately affected by environmental health issues. Themes of power and equity in terms of decision making, access to knowledge, and funding availability, will be woven into all aspects of the class and will underpin our analysis of the science.

**Attributes:** ENVI Natural World Electives GEOS Group B Electives - Sediments + Life PHLH Nutrition,Food Security+Environmental Health

Not offered current academic year

**GEOS 210 (F)(S) Oceanographic Processes**

**Cross-listings:** CAOS 210

Secondary Cross-listing

Part of the Williams-Mystic Coastal and Ocean Studies Program, this course provides an introduction to physical, geological, chemical, and biological oceanography. Using local field sites as well as places visited on field seminars, we will investigate why the Earth has oceans, why they are salty, how they move and flow, reasons for sea level change on both long and short timescales, and how our oceans interact with the atmosphere to control global climate. We will emphasise societal interactions with the ocean, and will consider coastal processes including land loss. We will apply an environmental justice and anti-racist lens to our discussions. Field work will take place on shores in southern New England, as well as during field seminars on the Atlantic ocean, the West Coast and the Mississippi River Delta. This course is in the Oceans and Climate group for the Geosciences major.

**Class Format:** Flipped classroom will focus on active learning using data-based exercises. Mini-symposia will involve student research and discussion.

**Requirements/Evaluation:** graded lab exercises, mini-symposium participation, and a research project

**Prerequisites:** none

**Enrollment Limit:** 24

**Enrollment Preferences:** none

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Unit Notes:** This course is taught at our Mystic Seaport campus. Students must be enrolled in the Williams-Mystic Coastal and Ocean Studies Program.

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

CAOS 210(D3) GEOS 210(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses GEOS Group A Electives - Climate + Oceans

Fall 2024

LEC Section: 01 TR 9:00 am - 10:15 am Lloyd B. Anderson

LAB Section: 02 TR 1:00 pm - 4:30 pm Lloyd B. Anderson

Spring 2025

LEC Section: 01 TR 9:00 am - 10:15 am Lloyd B. Anderson

LAB Section: 02 TR 1:00 pm - 4:30 pm Lloyd B. Anderson

**GEOS 211 (F) Rates and Dates: Calibrating the Rock Record** (WS)

Late in the eighteenth century, the Scottish naturalist, James Hutton, argued that Earth had "no vestige of a beginning, no prospect of an end" challenging the widely held biblical view that Earth was a mere 6,000 years old. Yet it was not until the discovery of radioactive decay that geologists were able to accurately date rocks and assign absolute ages to the geologic time scale, which had been developed using fossils and relative dating of rocks. Before radiometric dating, there were numerous attempts to estimate the age of Earth using the rates of natural phenomena, but these early approaches were plagued by faulty assumptions about geologic processes. We still endeavor to estimate the rate of a wide variety of geologic processes, and many are critical to society, such as climate change, sea-level rise, plate motions, and mass extinctions. In this tutorial, we explore the methods of radiometric dating that allow us to determine the age of igneous rocks that cooled from a magma, estimate when deeply buried metamorphic rocks cooled below certain temperatures, and determine the age of organic materials from their radiocarbon signatures. We then examine methods used to estimate the rates of geologic processes with particular emphasis on diffusion -- the movement of matter or energy in

response to a gradient in concentration, temperature, or potential energy -- and the explicit and implicit assumptions that are critical to rate calculations. Topics include the basic isotope systematics of geochronology (U-Pb, K-Ar, and 14C ages) and thermochronology (U-Th/He or 40Ar/39Ar), as well as the rates of processes such as plate motion, sea-level rise or fall, glacial advance or retreat, magma storage and ascent, and/or mineral growth rates. There will be weekly tutorial meetings with pairs of students, and students will alternate writing papers on assigned topics. This course is in the Solid Earth group for the Geosciences major.

**Requirements/Evaluation:** Four 5-page papers and four oral critiques of partner's papers, plus 2 problem sets

**Prerequisites:** Any 100-level Geosciences course

**Enrollment Limit:** 10

**Enrollment Preferences:** Geosciences majors or students with a strong interest in Geosciences.

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3) (WS)

**Writing Skills Notes:** Students will write four 5-page papers and will receive peer and instructor feedback on how to improve their writing skills and formulate sound arguments. In addition, there will be two quantitative problem sets.

**Attributes:** GEOS Group C Electives - Solid Earth

Fall 2024

TUT Section: T1 TBA Mike R. Hudak, Paul M. Karabinos

**GEOS 212 (S) Paleobiology**

**Cross-listings:** BIOL 211

Primary Cross-listing

The fossil record is a direct window into the history of life on Earth and contains a wealth of information on evolution, biodiversity, and climate change. This course investigates the record of ancient life forms, from single-celled algae to snails to dinosaurs. We will explore how, why, when, and where fossils form and learn about the major groups of fossilized organisms and how they have changed through time. In addition, we will cover a range of topics central to modern paleobiology. These include: how the fossil record informs our understanding of evolutionary processes including speciation; the causes and consequences of mass extinctions; how fossils help us tell time and reconstruct the Earth's climactic and tectonic history; statistical analysis of the fossil record to reconstruct biodiversity through time; analysis of fossil morphology to recreate the biomechanics of extinct organisms; and using fossil communities to reconstruct past ecosystems. Laboratory exercises will take advantage of Williams' fossil collections as well as published datasets to provide a broad understanding of fossils and the methods we use to study the history of life on Earth, including using the programming language R (no previous experience is required). We will also view a diversity of fossils in their geologic and paleo-environmental context on our field trip to Eastern New York. This course is in the Sediments and Life group for the Geosciences major.

**Class Format:** One day field trip to the the Paleozoic of New York State

**Requirements/Evaluation:** Weekly lab assignments, frequent short quizzes and writing assignments, and a final research projected presented in poster form.

**Prerequisites:** any 100-level GEOS course or BIOL 102, 203 or 205

**Enrollment Limit:** 24

**Enrollment Preferences:** sophomores, and junior GEOS majors

**Expected Class Size:** 20

**Grading:** no pass/fail option, no fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 212(D3) BIOL 211(D3)

**Attributes:** EXPE Experiential Education Courses GEOS Group B Electives - Sediments + Life MAST Interdepartmental Electives

Not offered current academic year

**GEOS 214 (S) Mastering GIS**

**Cross-listings:** ENVI 214

Primary Cross-listing

The development of Geographic Information Systems (GIS) has allowed us to investigate incredibly large and spatially complex data sets like never before. From assessing the effects of climate change on alpine glaciers, to identifying ideal habitat ranges for critically endangered species, to determining the vulnerability of coastal communities to storms, GIS has opened the door for important, large-scale environmental analyses. And as these technologies improve, our ability to understand the world grows ever greater. This course will teach you how to use GIS to investigate environmental problems. We will review fundamental principles in geography, the construction and visualization of geospatial datasets, and tools for analyzing geospatial data. Special attention will also be given to analysis of remotely sensed (satellite) imagery and to collection of field data. By the end of the course, you will be able to conduct independent GIS-based research and produce maps and other geospatial imagery of professional quality.

**Class Format:** lecture, three hours per week and laboratory, three hours per week

**Requirements/Evaluation:** weekly lab exercises, weekly quizzes, and a research project

**Prerequisites:** at least one course in Geosciences or Environmental Studies

**Enrollment Limit:** 18

**Enrollment Preferences:** Geosciences majors and Environmental Studies majors and concentrators.

**Expected Class Size:** 18

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

ENVI 214(D3) GEOS 214(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses

Spring 2025

LEC Section: 01 TR 8:30 am - 9:45 am Alex A. Apotsos

LAB Section: 02 T 1:00 pm - 4:00 pm Alex A. Apotsos

LAB Section: 03 R 1:00 pm - 4:00 pm Alex A. Apotsos

**GEOS 215 (S) Climate Changes** (QFR)

**Cross-listings:** CAOS 215

Primary Cross-listing

Paleoclimatology is the reconstruction of past climate variability and the forces that drove the climate changes. The Earth's climate system is experiencing unprecedented and catastrophic change because of anthropogenic emission of greenhouse gases and land use change. Paleoclimatology allows humans to put modern climate changes into the context of the history of this planet, and shows how and why it is unprecedented and catastrophic. Each climate event we study from Earth's past teaches us lessons on why the climate system responds to anthropogenic perturbations, what climate changes we're committed to in the future, how long-lasting they will be, and what climate consequences we can avoid if we take action and reduce greenhouse gas emissions sooner. In this course, we will discuss the major mechanisms that cause natural climate variability, how climate of the past is reconstructed, and how climate models are used to test mechanisms that drive climate variation. With these tools, you will analyze and interpret data and model simulations from climate events from Earth's history, and apply these findings to anthropogenic climate changes happening now and that are projected to happen in the future. Laboratories and homework will emphasize developing problem solving skills as well as sampling and interpreting geological archives of climate change. This course is in the Oceans and Climate group for the Geosciences major.

**Class Format:** This class has three scheduled lectures per week, and one lab meeting per week which will consist of field excursions, lab exercises, problem solving and discussion

**Requirements/Evaluation:** lab exercises and homework (25%), three quizzes (50%), and a final project (25%)

**Prerequisites:** 100-level course in GEOS, CHEM, or PHYS or ENVI 102 or permission of instructor

**Enrollment Limit:** 24

**Enrollment Preferences:** Geosciences majors and Environmental Studies majors and concentrators and Maritime Studies concentrators

**Expected Class Size:** 16

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 215(D3) CAOS 215(D3)

**Quantitative/Formal Reasoning Notes:** Labs and homework include quantitative problem solving, visualization and analysis of quantitative data, and scientific computing with Matlab. No previous programming experience is assumed.

**Attributes:** ENVI Natural World Electives EVST Environmental Science EXPE Experiential Education Courses GEOS Group A Electives - Climate + Oceans MAST Interdepartmental Electives

Not offered current academic year

**GEOS 234 (S) Introduction to Materials Science** (QFR)

**Cross-listings:** PHYS 234

Secondary Cross-listing

Materials Science is the study of how the microscopic structure of materials--whether steel, carbon fiber, glass, wood, plastic, or mayonnaise--determines their macroscopic mechanical, thermal, electric, and other properties. Topics of this course include classifying materials; material structure; thermodynamics and phase transformations; material properties and testing; how solids bend, flow, and ultimately break; and how to choose the right material for design applications. Materials Science is a highly interdisciplinary field and as a result the course prerequisites are broad but also flexible. Interested students who are unsure about their preparation are strongly encouraged to contact the instructor.

**Class Format:** lecture (3 hours per week) plus up to two small-group laboratory sessions throughout the semester (to be scheduled with instructor)

**Requirements/Evaluation:** weekly problem sets, class participation, midterm and final exams, and a 3-5 page paper and associated presentation, all of which have a substantial quantitative component

**Prerequisites:** high school physics and chemistry, preferably at the AP level, and MATH 140 or AP Calculus (BC), and one 100-level PHYS, CHEM, or GEOS course; or permission of instructor

**Enrollment Limit:** 24

**Enrollment Preferences:** based on students' scientific background and seniority

**Expected Class Size:** 20

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** This course does not count toward the Geosciences major.

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**

PHYS 234(D3) GEOS 234(D3)

**Quantitative/Formal Reasoning Notes:** Weekly problem sets and exams all have a substantial quantitative component.

**Attributes:** MTSC Courses

Spring 2025

LEC Section: 01 MR 2:35 pm - 3:50 pm Katharine E. Jensen

**GEOS 250 (F) Climate,Tectonics, and Erosion** (WS)

Traditionally tectonics investigated processes operating deep in the crust and mantle, whereas geomorphology focused on surficial processes that shape the landscape. This course explores the complex interactions between tectonic and surficial processes. It has long been recognized that crustal uplift during mountain building creates new landscapes, but we now suspect that variations in erosion rate can fundamentally influence the development of mountains. Climate plays a central role in this feedback loop; the rise of mountains can change climate, and such changes can alter regional erosion rates. This course will examine how geologists use characteristic markers to estimate the amount of surface uplift, methods for determining uplift rate, surface response to faulting and folding, measuring displacement of the crust with GPS and interferometry methods, how

mountain building affects erosion and exhumation rates, the limits to relief in mountains, and the interaction between mountains and climate. This course is in the Solid Earth group for the Geosciences major.

**Class Format:** After an initial group meeting, students will meet in pairs for one hour each week with the instructor; each student will orally present a written paper every other week for criticism during the tutorial session

**Requirements/Evaluation:** five 4- to 5-page papers based on journal articles

**Prerequisites:** at least one of the following courses: GEOS 101, 102, 103, 201, 215, 301, 302, 304, or permission of instructor

**Enrollment Limit:** 10

**Enrollment Preferences:** Geosciences majors and students with a strong interest in Geosciences

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3) (WS)

**Writing Skills Notes:** Five 4- to 5-page papers distributed throughout the semester. Students will receive from the instructor timely comments on their writing skills, with suggestions for improvement.

**Attributes:** GEOS Group C Electives - Solid Earth

Not offered current academic year

**GEOS 255 (F) Environmental Observation**

**Cross-listings:** ENVI 255

Primary Cross-listing

To study the environment, we need to observe and measure it. We collect data--numbers that represent system states--and analyze them to create understanding of the world we live in. Advances in technology create more opportunities to discover how the planet works. Through a survey of observational approaches (including weather stations, direct sampling, remote sensing, community-based monitoring, and other techniques), this course will investigate the process of turning a physical property in the environment into a number on a computer and then into meaningful information. We will explore both direct field measurements and remote sensing techniques, diving into how to choose the appropriate sensor for a scientific question, how sensors work, analysis approaches and statistical methods, and how to interpret the resulting data. We will also learn how to mitigate measurement bias through a combination of lab experiments and field work and how to make interpretations of measurements that accurately reflect what is being measured. The course will focus on the near-surface environment, including the atmosphere, water, and biosphere. Students will carry out a research project using observation techniques covered in class to explore a scientific question of interest. This course is in the Oceans and Climate group for the Geosciences major.

**Requirements/Evaluation:** Weekly labs, four quizzes, and a final project

**Prerequisites:** at least one prior course in GEOS or ENVI

**Enrollment Limit:** 20

**Enrollment Preferences:** sophomores, then GEOS majors

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 255(D3) ENVI 255(D3)

**Attributes:** ENVI Natural World Electives EXPE Experiential Education Courses GEOS Group A Electives - Climate + Oceans

Fall 2024

LEC Section: 01 MWF 10:00 am - 10:50 am Alice C. Bradley

LAB Section: 02 W 1:00 pm - 4:00 pm Alice C. Bradley

LAB Section: 03 R 1:00 pm - 4:00 pm Alice C. Bradley

**GEOS 275 (S) Ocean and Climate Changes**

Earth's oceans are a central part of the global climate system, and changes to the oceans throughout Earths history were often accompanied by dramatic climate shifts. In this class we will discuss the interconnected nature of oceans and climate, evidence for ocean and climate changes in the geologic past, what is happening to the oceans today, and what may happen in the future due to human-induced climate change. We will use computer models to explore ocean circulation in three dimensions, examine societal case studies to appreciate how people rely on the oceans, and analyze articles from the scientific literature to learn about the origins of foundational oceanographic knowledge and modern advances. Using marine sediment records, we will synthesize paleoclimate data and reconstruct past changes in the ocean and climate system. Through these explorations you will learn about the influence of the oceans on the global carbon system over both short and long timescales, and how changes in ocean circulation have altered Earth's energy balance. Using modern satellite data, we will investigate changes happening in the world's oceans today and assess the mechanisms thought to be responsible. We will visit a dedicated ocean research facility to learn about the tools and techniques employed by oceanographers to answer questions about our changing oceans. And, with the aid of emissions scenarios and probabilistic models, we will explore future scenarios of climate change and evaluate how the oceans will be affected by, and will in turn influence, the changing climate system.

**Requirements/Evaluation:** 2 lectures per week, one 3 hour lab per week. Students should expect to spend about 7 additional hours per week out of class working on course-related reading/homework/studying/project preparation. Readings, podcasts, and/or videos before most lecture and some lab meetings. Short, check-in quizzes.

**Prerequisites:** one 100-level GEOS course

**Enrollment Limit:** 24

**Enrollment Preferences:** sophomores, and junior Geos majors

**Expected Class Size:** 24

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

**Attributes:** GEOS Group A Electives - Climate + Oceans

Not offered current academic year

**GEOS 280 Carbon dioxide uptake and our climate future** (WS)

Because of the failure to substantially reduce global greenhouse gas emissions, it is now clear that removal of carbon dioxide already emitted to the atmosphere is necessary to meet the 1.5 degree Celsius maximum warming target to avoid severe and irreversible consequences from continued greenhouse gas emissions. Natural carbon sinks have already taken up two thirds of the excess carbon dioxide from the atmosphere, and these terrestrial and marine systems are being investigated to determine if this uptake can be enhanced by geoengineering: human intervention to offset the impacts of climate change. In addition, technologies are being developed to capture carbon dioxide directly from the atmosphere, though none are yet operating at a large enough scale and low enough cost. In this tutorial, students will study the terrestrial, near-coastal, and deep-ocean carbon cycles, and analyze both the capacity for future natural uptake, the potential augmented uptake that could be achieved by deliberate manipulation of these systems, and the impacts of these carbon cycle perturbations on ecosystems and humans. Students will evaluate the scientific basis behind real startup ventures and carbon credit schemes that capitalize on the exploding interest and investment in carbon uptake technologies. And they will write a research proposal for investigating and/or testing a scientifically compelling carbon uptake strategy. This course is in the Oceans and Climate group for the Geosciences major.

**Requirements/Evaluation:** evaluation will be based on the critical analysis of readings through discussion, writing and revision

**Prerequisites:** one GEOS course or ENVI 102

**Enrollment Limit:** 10

**Enrollment Preferences:** students with a strong interest in Geosciences, Geosciences majors, Environmental Studies majors and concentrators

**Expected Class Size:** 10

**Grading:**

**Distributions:** (D3) (WS)

**Writing Skills Notes:** Each student will write five 5-page papers and five 1-page response papers; students will give and receive feedback through peer review and tutorial meeting discussion and will develop their writing and critical analysis skills through revision.

**Attributes:** GEOS Group A Electives - Climate + Oceans

Not offered current academic year

**GEOS 301 (S) Geomorphology**

**Cross-listings:** ENVI 331

Primary Cross-listing

Geomorphology is the study of landforms, the processes that shape them, and the rates at which these processes change the landscape in which we live. The course is designed for Geosciences majors and for environmental studies students interested in the evolution of Earth's surface and the ways our activities are changing the planet. We will examine the ways in which climatic, tectonic, and volcanic forces drive landscape evolution over relatively short periods of geologic time, generally thousands to a few millions of years. More recently, the impacts of human activity in reshaping landscapes, determining the movement of water, and changing climate could not be clearer. We will also examine how these impacts are affecting communities, including causes and possible solutions to environmental injustice. We will explore local case studies of geomorphology, such as the impact of ice-age glaciation on landscapes in the northeastern United States and the legacy of deforestation and river damming during the colonial era. We will learn a range of practical skills for describing physical environments and for predicting how they change, including field surveys, GIS analysis, and numerical modelling. This course is in the Sediments and Life group for the Geosciences major.

**Class Format:** lecture, three hours per week and laboratory, three hours per week

**Requirements/Evaluation:** weekly lab exercises, a research project, and a midterm and final exam

**Prerequisites:** At least one 100-level and one 200-level GEOS or ENVI course or permission of instructor

**Enrollment Limit:** 18

**Enrollment Preferences:** GEOS and ENVI majors

**Expected Class Size:** 18

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 301(D3) ENVI 331(D3)

**Attributes:** AMST Space and Place Electives ENVI Natural World Electives EVST Environmental Science EXPE Experiential Education Courses GEOS Group B Electives - Sediments + Life

Spring 2025

LEC Section: 01 MW 11:00 am - 12:15 pmFriday Org Mtg 11:00 am - 12:15 pm Chris Halsted

LAB Section: 02 M 1:00 pm - 4:00 pm Chris Halsted

LAB Section: 03 W 1:00 pm - 4:00 pm Chris Halsted

**GEOS 302 (S) Sedimentology** (WS)

Sediments and sedimentary rocks are the book in which Earth's history is recorded, where we read the stories of ancient oceans and continents, and how life evolved. Sand and dirt preserve information about the rocks that were eroded to form them, the fluids and forces that transported them, the ways in which they were deposited, and the ecosystems that they supported. Understanding sediments is also fundamental to society, for many kinds of civil engineering as well as pollution and environmental remediation. We will investigate sediment composition, fluid mechanics, bedforms, and depositional environments, building to an integrated understanding of erosion, deposition, and changes over time. We will also acknowledge and examine the roles that racism and colonialism have played in sedimentologic research. This course is in the Sediments and Life group for the Geosciences major.

**Class Format:** lecture/discussion three hours per week and laboratory three hours per week; field trips: two half-day and one all-day

**Requirements/Evaluation:** lab and field exercises, writing assignments, participation in discussions

**Prerequisites:** At least one course in GEOS Group B (Solid Earth) AND one course in GEOS Group C (Sediments and Life); or permission of instructor

**Enrollment Limit:** 15

**Enrollment Preferences:** Geosciences majors

**Expected Class Size:** 12

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3) (WS)

**Writing Skills Notes:** Weekly 2-3 page writing assignments will be thoroughly edited for style, grammar, and syntax; each student will compile their

papers as a growing body of work, and each new assignment will be read and edited in the context of previous submissions.

**Attributes:** EXPE Experiential Education Courses GEOS Group B Electives - Sediments + Life MAST Interdepartmental Electives

Not offered current academic year

**GEOS 304 (S) Mineralogy and Petrology**

Minerals are Earth's basic building blocks. They form, deform, and transform in response to environment conditions, and in doing so, they record a wide range of processes in the Earth system. In this course, we will use minerals to understand the geologic record at multiple timescales, from the slow process of continental assembly and break-up to rapid processes such as volcanic eruptions and biogeochemical cycles. Central to this analysis is rock and mineral characterization. Therefore, laboratory and field studies will hone fundamental observational skills of minerals at multiple scales, from atomic scale crystalline structures to macroscopic physical properties in hand sample. Discussion of experimental and natural data (phase relationships, thermodynamics, and major and trace element geochemistry) in conjunction with these petrographic approaches, will create a framework for interpreting the dynamic processes and geologic settings where igneous and metamorphic rocks form. The semester will culminate in a final project that applies both the observation and interpretive skills developed, giving students the chance to collect data and "read the geologic record" left behind in rocks from around the world.

**Class Format:** three lectures per week with two lab sections.

**Requirements/Evaluation:** This class may include field trips, problem sets, 2-3 exams and an final project

**Prerequisites:** 1 100-level GEOS course

**Enrollment Limit:** 24

**Enrollment Preferences:** GEOS majors who have taken at least one 100-level GEOS course.

**Expected Class Size:** 24

**Grading:** yes pass/fail option, no fifth course option

**Distributions:** (D3)

**Attributes:** GEOS Group C Electives - Solid Earth

Spring 2025

LEC Section: 01 TR 11:20 am - 12:35 pm Mike R. Hudak

LAB Section: 02 R 1:00 pm - 4:00 pm Mike R. Hudak

LAB Section: 03 M 1:00 pm - 4:00 pm Mike R. Hudak

**GEOS 309 (F) Modern Climate** (QFR)

**Cross-listings:** CAOS 309

Primary Cross-listing

What will happen to the Earth's climate in the next century? What is contributing to sea level rise? Is Arctic sea ice doomed? In this course we will study the components of the climate system (atmosphere, ocean, cryosphere, biosphere and land surface) and the processes through which they interact. Greenhouse gas emission scenarios will form the basis for investigating how these systems might respond to human activity. This course will explore how heat and mass are moved around the atmosphere and ocean to demonstrate how the geographic patterns of climate change arise. We will also focus on climate feedback effects--like the albedo feedback associated with sea ice and glacier loss--and how these processes can accelerate climate change. In labs we will learn MATLAB to use process and full-scale climate models to investigate the behavior of these systems in response to increasing greenhouse gasses in the atmosphere. This course is in the Oceans and Climate group for the Geosciences major.

**Requirements/Evaluation:** 4 multi-week lab projects and several short quizzes

**Prerequisites:** Any of GEOS 100, GEOS 103, ENVI 102, GEOS 215, or permission of instructor

**Enrollment Limit:** 20

**Enrollment Preferences:** GEOS and ENVI majors

**Expected Class Size:** 20

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 309(D3) CAOS 309(D3)

**Quantitative/Formal Reasoning Notes:** Lab projects consist of a series of numerical climate modeling projects, which require significant quantitative and logical reasoning.

**Attributes:** ENVI Natural World Electives EVST Environmental Science GEOS Group A Electives - Climate + Oceans

Not offered current academic year

**GEOS 312 (F) Mass Extinctions: Patterns and Processes** (WS)

Over the last 541 million years of Earth history, five major mass extinctions have occurred, each dramatically changing the makeup and course of life on our planet. During some of these events, over 75% of all marine animal species went extinct; during others, groups like the dinosaurs vanished from the planet after tens of millions of years of ecological dominance. This tutorial course will explore the idea of extinction from the evolution of the concept in human thought to current research on the mechanisms and patterns of extinctions through time. We will examine what makes an extinction "mass", delve into the causes and consequences of the major mass extinction events of the Phanerozoic, and discuss the potential human-induced "6th extinction" event occurring in the present day. This course is in the Sediments and Life group for the Geosciences major.

**Class Format:** Weekly 1-hour tutorial meetings with pairs of students; one required all-day field trip.

**Requirements/Evaluation:** four 4-5-page papers, one revision, tutorial presentations, the student's effectiveness as a critic, and 1 problem set

**Prerequisites:** GEOS 107 or GEOS 212; or permission of instructor + any 200 level GEOS course

**Enrollment Limit:** 10

**Enrollment Preferences:** Geosciences majors

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3) (WS)

**Writing Skills Notes:** This is a tutorial that involves students writing 4 original response papers and one substantial revision to their writing.

**Attributes:** GEOS Group B Electives - Sediments + Life

Not offered current academic year

**GEOS 320 (S) Ecosystem ecology in the Anthropocene**

**Cross-listings:** BIOL 320 / ENVI 320

Secondary Cross-listing

Ecosystem ecology provides a framework for understanding the multidirectional interactions between biological organisms and their physical environments, and provides critical insight into our approaches for managing resource use in an era of anthropogenic change. In this class, we will explore the biological and biogeochemical underpinnings of ecosystem carbon and nutrient cycling. Topics will include interactions between species composition and ecosystem function, nutrient use efficiency, resource transformations, ecosystem management and restoration, and feedbacks to global change. Lecture content will be supported by regular discussions of the primary literature. Labs will introduce students to field and laboratory techniques to study resource and energy flow in local ecosystems, as well as approaches to project design, hypothesis development, data collection, and analysis. The laboratory program will culminate with a multi-week independent project.

**Class Format:** lectures, discussions, and a weekly lab

**Requirements/Evaluation:** Evaluation will be based on lab assignments, discussion participation, three exams, and an independent project

**Prerequisites:** BIOL/ENVI 203 or GEOS 208 or BIOL 211 or GEOS 212

**Enrollment Limit:** 12

**Enrollment Preferences:** Biology majors, then Environmental studies majors/concentrators or Geosciences majors

**Expected Class Size:** 12

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

BIOL 320(D3) ENVI 320(D3) GEOS 320(D3)

**Attributes:** ENVI Natural World Electives

Spring 2025

LEC Section: 01 MWF 11:00 am - 11:50 am Allison L. Gill

LAB Section: 02 T 1:00 pm - 3:50 pm Allison L. Gill

LAB Section: 03 TBA Cancelled Allison L. Gill

**GEOS 327 (F) Coastal Processes and Geomorphology** (QFR)

**Cross-listings:** ENVI 327 / CAOS 327

Primary Cross-listing

Can people live safely along the coast? Recent events like SuperStorm Sandy and the Tohoku Tsunami have shown us how the ocean can rise up suddenly and wreak havoc on our lives and coastal infrastructure. Only educated geoscientists can evaluate the risks and define informed strategies to prevent future coastal catastrophes. Currently almost half the global population lives within 100 km of the coast, with a large percent of those living in densely populated cities (e.g., New York, New Orleans, Los Angeles, Shanghai, Hong Kong, Cape Town, Sydney, Mumbai). Despite the growing risks and challenges associated with climate change and rising sea levels, the coastal population continues to grow rapidly. To help ensure these growing populations can live safely along the coast requires a detailed understanding of the processes that shape the coastal zone. These processes act across a variety of scales, from deep-time geologic processes that dictate coastal shape and structure, to decadal-scale processes that determine shoreline position and evolution, to weekly and daily processes such as storms and tides. This course will provide an in-depth look at the forces--wind, waves, storms, and people--that shape the coastal zone, as well as the geologic formations--sandy beaches, rocky cliffs, barrier islands, deltas, and coral reefs--that are acted upon and resist these forces. Coastal dynamics are strongly affected by human interventions, such as seawalls, dredged channels, and sand dune removal, as well as by sea level rise and changes in storm frequency and magnitude associated with climate change. Finally, the course will provide students with a perspective on how the U.S. seeks to manage its coastal zone, focusing on sea level rise and coastal development. This class will include a quantitative lab that will use MATLAB software to model and evaluate various coastal processes. Students will gain a basic understanding of MATLAB functionality, and will be asked to independently apply what they have learned to various data sets provided by the instructor.

**Class Format:** lecture two times a week with a lab one time per week

**Requirements/Evaluation:** lab reports, quizzes, and an independent research project

**Prerequisites:** Either GEOS 104 or GEOS 210; or permission of instructor. No prior knowledge is necessary, but this course does build on principles used to explore complex scientific challenges.

**Enrollment Limit:** 15

**Enrollment Preferences:** Geosciences majors

**Expected Class Size:** 15

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** This course counts toward the GEOS Group B Electives - Sediments + Life.

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**

ENVI 327(D3) GEOS 327(D3) CAOS 327(D3)

**Quantitative/Formal Reasoning Notes:** This course will involve the use of MATLAB software to quantitatively analyze coastal process and geomorphological data.

**Attributes:** ENVI Natural World Electives GEOS Group B Electives - Sediments + Life

Fall 2024

LEC Section: 01 MWF 8:30 am - 9:45 am Alex A. Apotsos

**GEOS 409 (F) Volcanology**

Volcanism can be defined as the set of processes by which magma and its associated gasses are transported through the crust and extruded to Earth's surface and atmosphere. This course will explore the underlying chemistry and physics that govern these processes and give rise to volcanic

systems as diverse in appearance and eruptive style as Kilauea, Mount St. Helens, and Yellowstone. Understanding a volcanic system and its associated hazards requires interdisciplinary approaches including field mapping, physical characterization of erupted products, geochemical analysis, and geophysical monitoring. Leveraging insights from these disciplines, we will develop a holistic view of volcanism sensu stricto: how magma is formed, transported, stored, and erupted on Earth. This course will also take a broader perspective recognizing that while individual eruptions may last for just seconds, the sum of volcanism over geologic time is immense. Through a combination of lectures, laboratory experiments, journal articles readings, reflections, and a final project, we will also interrogate the role of volcanoes in plate tectonics, global geochemical cycles, Earth's habitability, and mass extinctions. This course is in the Solid Earth group for the Geosciences major.

**Requirements/Evaluation:** weekly lab assignments, journal article presentations and discussions, final project

**Prerequisites:** One of the following: GEOS 102, GEOS 304, PHYS 131, or CHEM 151, or permission from the instructor

**Enrollment Limit:** 12

**Enrollment Preferences:** senior GEOS majors, then junior GEOS majors, then juniors and seniors with a prerequisite

**Expected Class Size:** 12

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

**Attributes:** GEOS Group C Electives - Solid Earth

Fall 2024

LEC Section: 01 TR 9:55 am - 11:10 am Mike R. Hudak

LAB Section: 02 T 1:00 pm - 4:00 pm Mike R. Hudak

**GEOS 410 (S) The Cryosphere**

**Cross-listings:** CAOS 410 / ENVI 410

Primary Cross-listing

The Earth's climate system is often described in terms of its spheres, including the atmosphere, biosphere, lithosphere, oceans, and the cryosphere. The cryosphere is the naturally occurring ice on Earth in all its many forms: snow, glaciers, ice sheets, sea ice, frozen lakes and rivers, and permafrost (frozen soil). These parts of the climate system may seem remote, but have implications for climate and weather around the world. Melting glaciers and ice sheets have already contributed to sea level rise, and are projected to do so even more in the future. This course will explore the cryosphere, including snow, sea ice, permafrost, and glaciers through lectures, hands-on and data analysis labs, reading journal articles, and a final project. As a 400-level seminar, this capstone course is intended to build on and extend knowledge and skills students have developed during previous courses in the major.

**Class Format:** Class periods and lab periods will be used interchangeably based on the weather.

**Requirements/Evaluation:** Evaluation will be based on short papers, labs responses, and a research project

**Prerequisites:** GEOS 215 or GEOS 255 or GEOS 309 or MAST 311 or permission of instructor

**Enrollment Limit:** 10

**Enrollment Preferences:** Senior GEOS majors, then other GEOS majors and senior ENVI majors

**Expected Class Size:** 10

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** As a 400-level seminar, this capstone course is intended to build on and extend knowledge and skills students have developed during previous courses in the major

**Materials/Lab Fee:** Labs will be outside during the winter: students should be prepared to dress appropriately for the weather.

**Distributions:** (D3)

**This course is cross-listed and the prefixes carry the following divisional credit:**

CAOS 410(D3) ENVI 410(D3) GEOS 410(D3)

**Attributes:** ENVI Natural World Electives GEOS Group A Electives - Climate + Oceans

Spring 2025

LEC Section: 01 WF 8:30 am - 9:45 am Alice C. Bradley

LAB Section: 02 M 8:30 am - 9:45 am Alice C. Bradley

**GEOS 414 (S) Reading Deep Time** (QFR)

Ancient sedimentary rocks and the fossils they contain are time machines - direct windows into the deep history of life on Earth and the environments that life inhabited. In this course you will learn to "read" these deep time records by collecting, interpreting, and analyzing paleontological, stratigraphic, and sedimentological data. The course will be organized around a week-long spring break trip to explore the rocks of the House Range of Utah. The Cambrian and Ordovician strata of the House Range offers an outstanding record of one of the most important periods in Earth history, tracking the rise of animal ecosystems and major increases in fossil diversity. The first 6 weeks of class will be spent learning the fundamentals of quantitative methods in paleontology and stratigraphy (often referred to as historical geology). Labs will focus on skill building including learning basic coding in R *(no experience needed or expected),* and learning how to interpret paleontological, sedimentological, and stratigraphic data. We will also read widely on the field locality and on the Cambrian and Ordovician Periods. During the field trip, we will explore the House Range. Students will learn skills including interpreting geological maps, measuring stratigraphic sections, finding and identifying fossils, and correlating rock units across basins. We will collect samples and data on the field trip and bring them back to Williams. The second 6 weeks of the course will be spent processing and analyzing the samples and data collected during the field trip, culminating in final projects to be done in small groups. Students will help determine what data we will collect in the field and what projects emerge. Examples might be interpreting carbon isotopic analyses to reconstruct ancient oceanographic conditions, biostratigraphic correlation using fossils to reconstruct basin dynamics, determining paleoenvironment based on analyses of thin sections, or digging into trilobite fossil preservation and evolutionary trends. Students will draw on previous experiences and course content in the Geosciences and bring small group research projects to completion by the end of the semester, which will be presented in poster form. This course fulfills the Geosciences Group B Elective: Sediments and Life.

**Class Format:** weekly lectures, paper discussions, and hands-on labs. Required week-long spring break field course.

**Requirements/Evaluation:** Short papers and lab assignments, spring break field course participation (REQUIRED), and a final group project presented in poster form.

**Prerequisites:** GEOS majors who have taken at least one of the following courses: GEOS 212, GEOS 203, GEOS 201, GEOS 301, GEOS 302, GEOS 312T, or permission of instructor.

**Enrollment Limit:** 12

**Enrollment Preferences:** Senior, and then Junior, Geosciences majors

**Expected Class Size:** 12

**Grading:** no pass/fail option, no fifth course option

**Unit Notes:** As a 400-level seminar, this capstone course is intended to build on and extend knowledge and skills students have developed during previous courses in the major

**Distributions:** (D3) (QFR)

**Quantitative/Formal Reasoning Notes:** This course will rely on the programming language R. Students will learn how to code in R, and will use R to analyze large data sets of geological data. The majority of labs, as well as the final project, will rely on R, statistical analyses, and wrangling data.

**Attributes:** GEOS Group B Electives - Sediments + Life

Not offered current academic year

**GEOS 470 (S) Science for Environmental Justice** (DPE)

**Cross-listings:**

Primary Cross-listing

Economically challenged communities and communities of color are disproportionately affected by environmental contamination and disturbance. Although environmental racism caused by industrial pollution has been made clear in scholarship for some time, the integrated stresses of climate change and industrial contamination are now triggering new challenges to life in underprivileged communities. Resolving environmental injustice will require meaningful engagement from scientists across a range of disciplines, from chemistry and the geosciences to ecology and public health. In this senior seminar, you will learn about the history of the environmental justice movement while examining how science has been used to address cases of environmental contamination and mismanagement. You can expect experiences in field data collection, laboratory analyses, and numerical modeling, skills that are required to assist communities suffering from environmental injustice. And we will work in partnership with residents of Tallevast, Florida, who have long suffered from the impacts of groundwater contamination and governmental neglect. This partnership will involve a residential field trip to Tallevast during spring break, where you will undertake an environmental study in support of the community.

**Class Format:** Weekly lectures, paper discussions, and hands-on labs. Required week-long spring break field trip.

**Requirements/Evaluation:** weekly lab exercises and seminar presentations; a research project; a final presentation; and a spring break field trip

**Prerequisites:** At least one 200-level Division III course and at least one 300-level Geosciences or Environmental Studies course or permission of instructor.

**Enrollment Limit:** 12

**Enrollment Preferences:** Fourth year, and then third year, Geosciences majors and Environmental Studies majors or concentrators

**Expected Class Size:** 12

**Grading:** no pass/fail option, no fifth course option

**Unit Notes:** As a 400-level seminar, this capstone course is intended to build and extend knowledge and skills that students have developed during previous courses in either the Geosciences or Environmental Studies majors.

**Materials/Lab Fee:** The spring break field trip is being funded by the Freeman Foote Field Trip Fund for the Sciences.

**Distributions:** (D3) (DPE)

**This course is cross-listed and the prefixes carry the following divisional credit:**

GEOS 470(D3)

**Difference, Power, and Equity Notes:** The course will examine the history of the environmental justice movement, unraveling the roles of governmental neglect and complicity in fostering the harm of vulnerable communities. We will review strategies of collective action in fighting climate and environmental injustice and the complicated role that scientists have played in this pursuit. We will then leverage scientific skills and perspectives to imagine ways that scientists can become responsible agents of change.

**Attributes:** GEOS Group B Electives - Sediments + Life

Not offered current academic year

**GEOS 493 (F) Senior Thesis: Geosciences**

Geosciences senior thesis; this is part of a full-year thesis (493-494).

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

Fall 2024

HON Section: 01 TBA Paul M. Karabinos

**GEOS 494 (S) Senior Thesis: Geosciences**

Geosciences senior thesis; this is part of a full-year thesis (493-494).

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

Spring 2025

HON Section: 01 TBA Paul M. Karabinos

**GEOS 497 (F) Independent Study: Geosciences**

Geosciences independent study.

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

Fall 2024

IND Section: 01 TBA Paul M. Karabinos

**GEOS 498 (S) Independent Study: Geosciences**

Geosciences independent study.

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3)

Spring 2025

IND Section: 01 TBA Paul M. Karabinos

**Winter Study ----------**

**GEOS 14 (W) Drawing Science Studio Lab**

*Drawing Science Studio Lab* explores the expansive intersection of art and science. Students will learn how to draw from direct observation of fossils, bones, plants, and taxidermy. This course is flexibly designed for every experience level. At least 75% of our class time is spent observing and drawing. Sketchbooks act as research sites. Graphite, colored pencils, and watercolors are our primary mediums. Most drawing will be done in-class with some additional at-home drawing assignments. The remaining class time is spent on research-driven field trips to WCMA, The Clark, and investigative walking assignments. We will have one visiting guest artist to add in our understanding of observation and depiction of the natural world. This course will explore: - how can observation, drawing, and related art games make us better visual thinkers and learners? - how do we see our environments? - how to color and pattern shape our perspectives (and then how do we draw that)? - how and where do scientific processes overlap with creative processes? - how does observation assist in field and lab work? - where does data-driven research benefit from play and imagination?

**Requirements/Evaluation:** Performance(s); Creative project(s); Other: Willingness to fail, willingness to take risks, dedication to sketchbooks

**Prerequisites:** None

**Enrollment Limit:** 12

**Enrollment Preferences:** Preference will be given to students who are curious about STEAM related fields and research and/or students of any level who wish to develop their drawing habits.

**Expected Class Size:** NA

**Grading:** pass/fail only

**Unit Notes:** Lauren Levato Coyne is an interdisciplinary artist exploring art, science, and storytelling. In addition to an extensive exhibition history, The Audubon Society commissioned Levato Coyne to create new work for their 125th Anniversary issue (2024).

**Materials/Lab Fee:** $47

**Attributes:** EXPE Experiential Education Courses SLFX Winter Study Self-Expression

Winter 2025

STU Section: 01 F 10:00 am - 4:00 pm Lauren Rachel Levato Coyne

**GEOS 16 (W) Fire and Ice**

The famously otherworldly landscapes of Iceland are a result of the combined forces of widespread volcanism and glaciation. Iceland is a rare subaerial portion of a mid-ocean ridge, where tectonic plates are pulling apart, so the volcanism and tectonic forces we can observe there are fairly unique. Owing to its high northern latitude, the island was completely glaciated (until ~13,000 years ago) and it still retains several ice caps. The landscape is sculpted by vast ridges and mountains formed from subglacial eruptions and is carpeted by post-glacial lavas at low elevations and active glaciers at high elevations. In the Land of Fire and Ice there is also vigorous geothermal activity from geysers to hot springs, which is ubiquitously used for electricity and hot water. This proposed travel course will explore the driving volcanic and glacial processes that formed the landscapes and continue to shape Icelandic culture. What are the characteristics of rift settings? How do subglacial eruptions differ from subaerial ones? What hazards are associated with volcano-ice interactions? Why do we find ice caps with outlet glaciers in these particular parts of Iceland? What can icebergs tell us about glacial ice? How does the North Atlantic climate shape the landscape and the winter season in Iceland? And how have Icelanders learned to coexist with and take advantage of these immutable and elemental forces of nature? In addition to the week of field study in Iceland, the class would include a week and a half of lectures, so that students are adequately prepared with a volcanology and glaciology background to fully appreciate the

trip. Students would complete a two-part project in which they prepare a presentation on a topic associated with one of the field trip sites to be delivered during the trip, and then follow the trip up with a report expanding on their experience and their review of the related scientific literature.

**Requirements/Evaluation:** paper(s) or report(s)

**Prerequisites:** GEOS 409 or enrollment in GEOS 410 in Spring 2025

**Enrollment Limit:** 20

**Enrollment Preferences:** Enrollment preference will be given to senior Geoscience majors who recently completed GEOS 409 (Volcanology) or are enrolled in GEOS 410 (The Cryosphere)

**Expected Class Size:** 20

**Grading:** pass/fail only

**Materials/Lab Fee:** $0

**Attributes:** GEOS Group A Electives - Climate + Oceans  GEOS Group C Electives - Solid Earth  TRVL Winter Study Travel Course

Winter 2025

TVL Section: 01  TR 1:00 pm - 4:00 pm  Alice C. Bradley,  Mike R. Hudak

**GEOS 17  (W)  Hurricanes / Typhoons and Global Warming**

Since 1990, forty-seven tropical depressions of hurricane intensity have developed on average each year mainly in the northern hemisphere. Among them, a half-dozen become major storms in the North Atlantic Ocean, another 10 are generated in the eastern Pacific Ocean, and as many as 22 take hold over the western Pacific Ocean (where they are called typhoons). Whereas the numbers have remained relatively static, evidence suggests that storm intensity is on the rise. Most such storms dissipate in the open oceans, but elsewhere coastal impact affects the physical geography of rocky shores, beaches, and river deltas, as well as the infrastructure associated with human habitation and commerce. During the Pliocene warm period between 4.5 to 3.0 million years ago, the average global temperature was both higher than today and global sea level stood above today's datum. These conditions may have contributed to permanent El Niño conditions across the Pacific Ocean having a spill-over effect on the Atlantic Ocean. With few exceptions since 2015, each succeeding year through 2023 has recorded an increase in the average global temperature. Air temperature affects sea-surface temperature, which is the key factor triggering hurricanes / typhoons on a seasonal basis today. This course looks at the physical evidence for storm deposits of exceptional size from the Pliocene warm period and the last inter-glacial epoch roughly 125,000 years ago. In the northern hemisphere, such deposits are well studied along the shores of Mexico's Gulf of California as well as islands such as the Azores in the North Atlantic. The physical dynamics of recent hurricanes are reviewed for further insight on where and how coastal impact is most expected.

**Requirements/Evaluation:** Presentation(s); Other: participation in discussion of assigned readings

**Prerequisites:** None

**Enrollment Limit:** 10

**Enrollment Preferences:** Evidence of prior course work in the Geosciences and/or Environmental Studies departments will be used.

**Expected Class Size:** NA

**Grading:** pass/fail only

**Unit Notes:** Markes Johnson is Professor Emeritus in the Geosciences Department at Williams College and the author of several books on the geology and ecology of Mexico's Baja California, including Baja California's Coastal Landscapes Revealed (2021).  His latest

**Materials/Lab Fee:** $24

**Attributes:** EXPE Experiential Education Courses  STUX Winter Study Student Exploration

Winter 2025

LEC Section: 01  Cancelled

**GEOS 22  (W)  Geosciences Research**

Students will spend part of Winter Study doing fieldwork collecting data. Back at Williams, they will analyze the data. Each student will have responsibility for a subset of the data, and the individual sub-projects will contribute to the overall research.

**Class Format:** to be arranged with instructor

**Requirements/Evaluation:** final project

**Prerequisites:** two Geosciences courses; permission of the instructor required before registering for the course

**Enrollment Limit:** 3

**Expected Class Size:** 3

**Grading:** pass/fail only

Winter 2025

RSC Section: 01 TBA Rónadh Cox

**GEOS 31 (W) Senior Thesis: Geosciences**

To be taken by students registered for Geosciences 493-494.

**Class Format:** thesis

**Grading:** pass/fail only

**Distributions:** (D3)

Winter 2025

HON Section: 01 TBA Paul M. Karabinos

**GEOS 99 (W) Independent Study: Geosciences**

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

**Class Format:** independent study

**Grading:** pass/fail only

Winter 2025

IND Section: 01 TBA Paul M. Karabinos