GEOSCIENCES (DIV III)

Chair: Professor Rónadh COX

Professors: R. COX, D. DETHIER, P. KARABINOS, B. WOBUS. Associate Professors: M. COOK, L. GILBERT. Assistant Professors: P. COHEN, J. CONSTANTINE. Lecturer: A. APOSTOS. Research Associates: BAARLI, BRANDRISS.

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, gemology, the energy and mining industries, outdoor education, 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.

The Geosciences major includes at least one and at most two 100-level courses:

GEOS 101 The Co-Evolution of Earth and Life
GEOS 102 An Unfinished Planet
GEOS 103 Global Warming and Natural Disasters
GEOS 104 Oceanography

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

GEOS 201 Geomorphology
GEOS 202 Mineralogy
GEOS 205 Earth Resources
GEOS 210/MAST 211 Oceanographic Processes
GEOS 212/BIOL 211 Paleobiology
GEOS 214 Remote Sensing and Geographic Information Systems
GEOS 215 Climate Changes

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

GEOS 301 Structural Geology
GEOS 302 Sedimentology
GEOS 303 Igneous and Metamorphic Petrology

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 411 Geobiology

Finally, students must take enough electives to bring the total to a minimum of nine courses.

PREPARATION FOR GRADUATE SCHOOL

Although many of our majors take geoscience jobs after graduation, many choose to go to graduate school, and most graduate programs will expect students to have a background in mathematics as well as a year or so of study in related sciences, in addition to the requirements of the Geosciences major. Students considering graduate work in geosciences should therefore consult with faculty to ensure that they plan wisely. 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.

THE DEGREE WITH HONORS IN GEOSCIENCES

The degree with honors in Geosciences provides students with an opportunity to undertake an 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 a program of independent research are interest and motivation, mastery of fundamental material and skills, and ability to pursue independent study successfully. Interested students should talk to members of the department 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 Geosciences major. Although most study-away programs do not offer geoscience courses, there are some that dovetail well with a Geosciences major. 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 as part of the Geosciences major. The Department Chair is always happy to discuss student plans and ideas for off-campus work. You can find general study away guidelines for the Geosciences here.

GEOS 101(F) The Co-Evolution of Earth and Life
Crosslistings: GEOS 101/ENVI 105
Primary Crosslisting
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 consider the inter-related nature of 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, examine many of its feedbacks, and learn about the dramatic changes that have occurred throughout the history of the Earth. 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, how can we detect that in the rock record, and how did this biological event lead to profound changes in the environment? How and why did animals evolve and what role did environmental change play in the radiation of animal life? How did the rise and radiation 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 history, with special attention paid to the geological and paleontological history of the northeastern United States.
Class Format: lecture; one laboratory per week plus one all-day field trip
Requirements/Evaluation: evaluation will be based on lab work, short quizzes, midterms, a writing project, and a final exam
Prerequisites: none
Enrollment Preferences: underclassmen
Enrollment Limit: 30
Expected Class Size: 30
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-A Electives

Fall 2016
LEC Section: 01 MWF 10:00 AM 10:50 AM Instructor: Phoebe Cohen

LAB Section: 02 M 01:00 PM 03:00 PM Instructor: Phoebe Cohen

LAB Section: 03 T 01:00 PM 03:00 PM Instructor: Phoebe Cohen

GEOS 102(S) An Unfinished Planet
The Earth is a work-in-progress, an evolving planet whose vital signs—as expressed by earthquakes, volcanic eruptions, and shifting plates—are still strong. In a geological time frame, nothing on Earth is permanent: ocean basins open and close, mountains rise and fall, continental masses accrete and separate. 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 past 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, a primary source supplement, selected writings of John McPhee, and references about the geology of the Northeast.
Class Format: lecture, three hours per week; lab (several 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: evaluation will be based on two hour-tests, weekly lab work, and a scheduled final exam
Prerequisites: none
Enrollment Preferences: first-year and sophomore students
Enrollment Limit: 40
Expected Class Size: 40
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives

Spring 2017
LEC Section: 01 MWF 10:00 AM 10:50 AM Instructor: Bud Wobus

LAB Section: 02 W 01:00 PM 03:00 PM Instructor: Bud Wobus

LAB Section: 03 R 01:00 PM 03:00 PM Instructor: Bud Wobus

GEOS 103(F) Global Warming and Natural Disasters
Crosslistings: GEOS 103/ENVI 103
Primary Crosslisting
The destruction caused by recent storms such as Irene and Sandy, devastation of prolonged drought in the African Sahel, catastrophic flooding and mudslides in SE Asia and sea level encroachment on the Alaska coast are visible examples of natural disasters that may be modulated by climate change. Global climate change, together with environmental degradation and the explosive growth of urban areas, has the potential to increase the severity and impact of natural disasters. In this course we globally examine geological and climatological processes that "set up" natural disasters such as hurricanes, floods, landslides, droughts, extreme temperatures, and coastal surges, as well as the processes that condition availability of water resources. We study in detail the causes and anticipated consequences of human alteration of global climate and its impact on the spectrum of natural hazards and resources. During laboratory sessions we use local field sites and computer models to analyze recent disasters/hazards, trends in weather and climate and options for mitigating future impacts.
Class Format: lectures, 3 hours per week; laboratory, 2 hours per week
Requirements/Evaluation: evaluation based on written reports from laboratories, class participation, two hour exams and a final exam
Prerequisites: none
Enrollment Preferences: first-year and sophomore students
Enrollment Limit: 40
Expected Class Size: 20
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-A Electives, SCST Related Courses

Fall 2016
LEC Section: 01 MWF 09:00 AM 09:50 AM Instructor: Alex Apotsos

LAB Section: 02 M 01:00 PM 03:00 PM Instructor: Jose Constantine

LAB Section: 03 W 01:00 PM 03:00 PM Instructor: Alex Apotsos

GEOS 104(S) Oceanography
Crosslistings: GEOS 104/ENVI 104/MAST 104
Primary Crosslisting
The oceans cover about 72% of Earth's surface, yet we know the surface of Venus better than our own ocean floors. Why is that? This integrated introduction to the oceans covers formation and history of the ocean basins; the composition and origin of seawater; currents, tides, and waves; ocean-atmosphere interactions; oceans and climate; deep-marine environments; coastal processes; productivity in the oceans; and human impacts. Coastal oceanography will be investigated on an all-day field trip, hosted by the Williams-Mystic program in Connecticut.
Class Format: lecture/discussion, three hours per week; laboratory, two hours per week in alternate weeks/one all-day field trip
Requirements/Evaluation: evaluation will be based on two hour exams, lab work, participation in the field trip, and a final exam
Extra Info: may not be taken on a pass/fail basis
Prerequisites: none
Enrollment Preferences: first-year and sophomore students
Enrollment Limit: 48
Expected Class Size: 48
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-A Electives, EXPE Experiential Education Courses

Spring 2017
LEC Section: 01 MWF 09:00 AM 09:50 AM Instructor: Mea Cook

LAB Section: 02 M 01:00 PM 03:00 PM Instructor: Mea Cook

LAB Section: 03 W 01:00 PM 03:00 PM Instructor: Mea Cook

GEOS 108(S) Observing Writing (W)
Crosslistings: GEOS 108/ENVI 112/COMP 109
Primary Crosslisting
There are many ways to write stories about the planet that we live on. Beautiful ideas can be expressed in fiction, in journalism, and in formal scientific writing. In this course we will investigate the earth by reading about it, by writing about it, and by analysing the writings of others. We will think about the ways in which fiction can be true, how journalism can be both clear and correct, and how scientific articles can be made accessible and interesting. All these things are in the hands of the writer. We will focus on both the act of writing (writing about observations) and analysis of the writings of others (observations about writing). We will write in and about the natural world, thinking about how to do so in ways that are evocative, interesting, and true. And we will read the writings of others, asking ourselves whether and how the writers have succeeded in being evocative, interesting, and true.

Class Format: seminar
Requirements/Evaluation: continuous assessment of drafts and rewrites, and class participation
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: a piece of writing should be submitted to instructor, describing the student's interests
Enrollment Preferences: first years, especially prospective Environmental Studies or Geoscience majors
Enrollment Limit: 10
Expected Class Size: 10
Distributional Requirements: Division 3, Writing Intensive

Spring 2017
SEM Section: 01 TF 01:30 PM 03:45 PM Instructor: Ronadh Cox

GEOS 201(F) Geomorphology
Crosslistings: GEOS 201/ENVI 205
Primary Crosslisting
This course is designed for Geosciences majors and for environmental studies students interested in surficial geologic processes and their importance in shaping the physical environment. Geomorphology is the study of landforms, the processes that shape them and the rates at which surface processes change the landscape. This class emphasizes the influence of climatic, tectonic, and volcanic forces on landform evolution over relatively short periods of geologic time, generally thousands to a few millions of years. At this time scale, the influence of human activity and climate change on landforms may be strong, perhaps dominant, in many geologic environments. Many of our examples analyze human interaction - planned or unplanned— with geomorphic processes. Labs focus on field measurements of channels and landscapes in the Williamstown area as well as on the analysis of topographic maps and stereo air photos.
Class Format: lecture/discussion, three hours per week; laboratory, three hours per week/student projects; weekend field trip to the White Mountains
Requirements/Evaluation: evaluation will be based on two hour exams, a project, lab work and class participation
Prerequisites: any 100-level GEOS course or permission of instructor
Enrollment Limit: 18
Expected Class Size: 15
Distributional Requirements: Division 3
Other Attributes: AMST Space and Place Electives, ENVI Natural World Electives, ENVS Group EG-B Electives, EVST Environmental Science

Fall 2016
LEC Section: 01 TR 08:30 AM 09:45 AM Instructor: David Dethier

LAB Section: 02 T 01:00 PM 04:00 PM Instructor: David Dethier

GEOS 202(S) Mineralogy
This course could be subtitled "An Introduction to Earth Materials and Analytical Techniques." As the basis for all subsequent solid-earth courses in the major, it provides a systematic framework for the study of minerals—Earth's building blocks: their physical and chemical properties at all scales and the common analytical methods used to identify and interpret them. The course progresses from hand-specimen morphology and crystallography through element distribution and crystal chemistry to the phase relations, compositional variation, and mineral associations within major rock-forming mineral systems. Laboratory work includes the determination of crystal symmetry; mineral separation; the principles and applications of optical emission spectroscopy; wavelength- and energy-dispersive x-ray spectrochemical analysis; x-ray diffraction; the use of the petrographic microscope; and the identification of important minerals in hand specimen and thin section.
Class Format: lecture, three hours per week; laboratory, three hours per week; independent study of minerals in hand specimen; one afternoon field trip
Requirements/Evaluation: evaluation will be based on one hour test, lab work, and a final exam
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: one 100-level GEOS course or permission of instructor
Enrollment Preferences: sophomores and juniors planning to take GEOS 301, 302 and/or 303 in the subsequent year
Enrollment Limit: 14
Expected Class Size: 12
Distributional Requirements: Division 3
Other Attributes: MTSC Related Courses

Spring 2017
LEC Section: 01 TR 08:30 AM 09:45 AM Instructor: Bud Wobus

LAB Section: 02 T 01:00 PM 04:00 PM Instructor: Bud Wobus

GEOS 205 Earth Resources
Crosslistings: GEOS 205/ENVI 207
Primary Crosslisting
The metal in your soda can, the plastic in your Nalgene, the components of your computer, the glass in your window, the hydrocarbons being burned to keep you warm in the winter or to transport you in cars or aircraft, the cars and aircraft themselves: all are made of materials mined from the Earth. Right now there are more people building more houses, paving more roads, making more vehicles,

more electronics, and more plastic packaging—all with geologic materials. As demand soars in both established and growing economies, and as we realize the environmental damage that can result from resource extraction and processing, the importance of understanding Earth's resources increases. Finding new deposits and managing those we have requires insight into the geology that underlies the location and origin of strategic Earth materials. This class introduces the geologic processes that control formation, distribution, and extent of materials reserves: dimension stone and gravel, base and precious metal ores, gemstones, petroleum, nuclear energy sources, and specialty materials for medical, technological, and military uses.
Class Format: lecture
Requirements/Evaluation: one hour exam, a final exam, lab exercises, and class participation
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: one 100-level GEOS course or permission of instructor
Enrollment Preferences: sophomores and Geosciences majors
Enrollment Limit: 18
Expected Class Size: 18
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EG-C Electives

Not Offered Academic Year 2017
LEC Instructor: Ronadh Cox

GEOS 206(F) Renewable Energy and the Sustainable Campus
Crosslistings: GEOS 206/ENVI 206
Primary Crosslisting
Rising oil and electricity costs disrupt the economy and help fuel global insecurity. Extraction of fossil fuels degrades the environment. Clearer understanding of how fossil-fuel consumption contributes to global climate change is increasing the demand for renewable sources of energy and for more sustainable campus environments. What sources of energy will supply Williams College and nearby areas in the twenty-first century? How will campus buildings, old and new, continue to be attractive spaces while making far more efficient use of heat and light? How can the College's operations and purchasing become more sustainable? This course is a practical introduction to renewable sources of energy, including conservation, principles of sustainability, and to their application to the campus environment. Topics covered include: biological sources of energy (biomass, biogas, liquid fuels), wind energy, geothermal and solar energy, energy efficiency and the environmental impacts of using renewable energy. Lectures, field trips and individual projects emphasize examples from the campus and nearby area.
Class Format: seminar, three hours per week
Requirements/Evaluation: evaluation will be based on an hour exam, class participation that includes a seminar presentation, and a research project that investigates some aspect of campus energy use and greenhouse-gas emissions
Enrollment Preferences: sophomores
Enrollment Limit: 20
Expected Class Size: 20
Distributional Requirements: Division 3
Other Attributes: AMST Space and Place Electives, ENVI Natural World Electives, ENVS Group EG-C Electives, EXPE Experiential Education Courses

Fall 2016
LEC Section: 01 MWF 11:00 AM 12:15 PM Instructor: David Dethier

GEOS 210(F,S) Oceanographic Processes
Crosslistings: MAST 211/GEOS 210
Secondary Crosslisting
This course examines ocean and coastal environmental science issues including carbon dioxide and the ocean's role in climate, El Niño and other ocean-atmosphere oscillations that influence our weather, coastal erosion and other hazards, coastal pollution, and fisheries. The focus is on controlling processes with regional comparisons. Blue water oceanography is conducted in the Atlantic and comparative coastal oceanography includes trips to southern New England shores, and the West and Gulf coasts of the US as part of the Williams-Mystic program.
Class Format: lecture/laboratory, including coastal and near-shore field trips, 11 days offshore, and a laboratory or field research project
Requirements/Evaluation: two tests, a research project, and a presentation
Extra Info: offered only at Mystic Seaport
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-C Electives, EVST Living Systems Courses, EXPE Experiential Education Courses

Fall 2016
LEC Section: 01 TBA Instructor: Lisa Gilbert

Spring 2017
LEC Section: 01 TBA Instructor: Lisa Gilbert

GEOS 212(S) Paleobiology
Crosslistings: GEOS 212/BIOL 211
Primary Crosslisting

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. In addition to the intellectual discovery of fossils as organic relics and the ways in which fossils have been used to support conflicting views on nature, geologic time, and evolution, 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' superb 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. We will also view a diversity of fossils in their geologic and paleo-environmental context on our field trip to Eastern New York.
Class Format: lecture/laboratory; field trip to the the Paleozoic of New York State
Requirements/Evaluation: evaluation will be based on lab assignments, short quizzes and writing assignments, and a final exam
Prerequisites: any 100-level GEOS course or BIOL 102, 203 or 205
Enrollment Preferences: sophomores and juniors
Enrollment Limit: 15
Expected Class Size: 12
Dept. Notes: does not satisfy the distribution requirement in the Biology major
Distributional Requirements: Division 3
Other Attributes: MAST Interdepartmental Electives

Spring 2017
LEC Section: 01 TR 09:55 AM 11:10 AM Instructor: Phoebe Cohen

LAB Section: 02 W 01:00 PM 04:00 PM Instructor: Phoebe Cohen

GEOS 214(S) Remote Sensing and Geographic Information Systems
Crosslistings: GEOS 214/ENVI 214
Primary Crosslisting
This class provides a practical look at fast-evolving methods used to integrate information about the Earth's surface with spatial data collected by disciplines such as archaeology, economics, the field sciences, history and political science. Remote sensing involves collection and processing of data from satellite and airborne sensors to yield environmental information about the Earth's surface and lower atmosphere. Remote sensing allows regional mapping of rock materials, analysis of vegetation cover and measurement of urban areas and land-use change over time. A Geographic Information System (GIS) links satellite-based environmental measurements with spatial data such as topography, transportation networks, and political boundaries, allowing display and quantitative analysis at the same scale using the same geographic reference. This course covers concepts of remote-data capture and geographic rectification using a Global Positioning System (GPS), as well as principles of remote sensing, including linear and non-linear image enhancements, convolution filtering, and image classification. Principles of GIS include display and classification, spatial buffers, logical overlays and techniques of spatial analysis. Weekly labs focus on training in the application of techniques using data from the region and other areas of North America.
Class Format: lecture, three hours per week; laboratory, three hours per week
Requirements/Evaluation: based on weekly lab exercises, two take-home exams and a final project
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: at least one introductory course in BIOL, ENVI, or GEOS
Enrollment Preferences: Geosciences and Biology majors and Environmental Studies majors and concentrators
Enrollment Limit: 15
Expected Class Size: 15
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EG-C Electives, ENVS Methods Courses, EXPE Experiential Education Courses

Spring 2017
LEC Section: 01 MW 11:00 AM 12:15 PM Instructor: Jose Constantine

LAB Section: 02 M 01:00 PM 04:00 PM Instructor: Jose Constantine

GEOS 215(S) Climate Changes (Q)
Crosslistings: GEOS 215/ENVI 215
Primary Crosslisting
In recent years, there has been a growing public and scientific interest in the Earth's climate and its variability. This interest reflects both concern over future climate changes resulting from anthropogenic increases in atmospheric greenhouse gases and growing recognition of the economic impact of "natural" climate variability (for example, El Niño events), especially in the developing world. Efforts to understand the Earth's climate system and predict future climate changes require both study of parameters controlling present day climate and detailed studies of climate changes in the past. In this course, we will review the processes that control the Earth's climate, like insolation, the greenhouse effect, ocean circulation, configuration of continents, and positive and negative feedbacks. At the same time, we will review the geological record of climate changes in the past, examining their causes.
Laboratory exercises and problem sets will emphasize developing problem solving skills and using quantitative analyses to assess if a given explanation is possible and reasonable. These exercises will include developing and applying numerical models of the radiative balance of earth and the carbon cycle.
Class Format: lecture, three hours per week; one three-hour lab per week

Requirements/Evaluation: evaluation will be based on lab exercises and problem sets (25%), three hour exams (50%), and a final project (25%) where students will collect, analyze, and interpret data
Prerequisites: 100-level course in GEOS, CHEM, or PHYS or permission of instructor
Enrollment Preferences: Geosciences majors
Enrollment Limit: 20
Expected Class Size: 20
Distributional Requirements: Division 3, Quantitative/Formal Reasoning
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-B Electives, EVST Environmental Science, MAST Interdepartmental Electives, SCST Related Courses

Spring 2017
LEC Section: 01 TR 08:30 AM 09:45 AM Instructor: Mea Cook

LAB Section: 02 T 01:00 PM 04:00 PM Instructor: Mea Cook

GEOS 217T Planets and Moons (W)
Crosslistings: GEOS 217/ASTR 217
Primary Crosslisting
We live in a solar system full of wonders. Each planet and each moon is strange: different from our Earth, and different from each other. The recent flood of images and data from Mars constantly reveals new marvels—the rest of the solar system is even stranger. The U.S. put men on the moon; there are robots on Mars; and the Soviet Union landed several times on Venus. The other worlds are known only from flybys and remote images, but it's amazing how much those can teach us. By focusing on recent research, we will examine how the solar system works and delve into its mysteries. Topics may include the possible Late Heavy Bombardment of the moon, runaway greenhouse on Venus, water on Mars, hidden oceans on Europa, and the methane weather cycle on Titan.
Class Format: tutorial
Requirements/Evaluation: six 1500-word papers, discussion & critical analysis;strong focus on polished writing & argument, & papers will be thoroughly edited by the professor for style, grammar & syntax
Extra Info: students will improve writing by integrating into successive papers the editorial comments they receive, & also by editing the writing of their tutorial partners
may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: any GEOS course, or permission of instructor
Enrollment Preferences: sophomores
Enrollment Limit: 10
Expected Class Size: 10
Distributional Requirements: Division 3, Writing Intensive

Not Offered Academic Year 2017
TUT Instructor: Ronadh Cox

GEOS 226T The Oceans and Climate (W)
Crosslistings: GEOS 226/ENVI 226/MAST 226
Primary Crosslisting
The oceans are a fundamental part of Earth's climate system. Ocean currents redistribute heat and water vapor around the globe, controlling temperature and precipitation patterns. Marine phytoplankton blooms and air-sea gas exchange modulate the atmospheric carbon dioxide concentration. The dynamic interaction of the atmosphere and the sea surface results in multi-year climate variations such as the El Niño-Southern Oscillation. This course will examine gradual and abrupt climate shifts from Earth's history and the ocean's role in driving, amplifying or dampening the changes, the ocean's response to anthropogenic greenhouse gas emissions, and the projected impacts of continued emissions and climate change on the ocean in the coming decades and millennia. We will analyze articles from the scientific literature that lay out the theory on the ocean's influence on climate, reconstruct past climate and ocean changes, test the mechanisms responsible for those changes, and with that knowledge, project the consequences of continued anthropogenic greenhouse gas emissions. Topics may include the climate effects of opening and closing seaways with plate tectonics, ocean feedbacks that amplify the intensity of ice ages, the instability of ocean circulation during ice-sheet retreat, the evolution of the El Niño-Southern Oscillation with changing carbon dioxide through the geologic past and the next century, ocean heat and carbon dioxide uptake during the last century and into the future, and the impact on sea level, seafloor methane reservoirs, ocean acidification, oxygenation and marine ecosystems.
Class Format: tutorial
Requirements/Evaluation: each student will write five 5-page position papers; evaluation based on the critical analysis of reading from the scientific literature through writing and discussion
Extra Info: may not be taken on a pass/fail basis, not available for the fifth course option
Prerequisites: GEOS 104, GEOS 210 or permission of instructor
Enrollment Preferences: sophomores and juniors
Enrollment Limit: 10
Expected Class Size: 10
Distributional Requirements: Division 3, Writing Intensive
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-B Electives, ENVS Group EG-C Electives, MAST Interdepartmental Electives, SCST Related Courses

Not Offered Academic Year 2017
TUT Instructor: Mea Cook

GEOS 258(S) Coastal Processes and Geomorphology
Crosslistings: GEOS 258/ENVI 258/MAST 258
Primary Crosslisting
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. Helping these growing populations to 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 an all-expenses-paid Spring Break field trip to the Outer Banks in North Carolina to collect oceanographic and geomorphologic data in conjunction with researchers at the U.S. Army Corps of Engineers Field Research Facility. Labs in the course will focus on analysis of the data collected during the field trip, and data collected previously at the Facility.
Class Format: lecture; will likely be a combination of lectures and discussions
Requirements/Evaluation: problem sets/lab reports, two short tests, and a research project
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: GEOS 104 or permission of instructor
Enrollment Limit: 10
Expected Class Size: 10
Distributional Requirements: Division 3

Spring 2017
LEC Section: 01 MWF 08:30 AM 09:45 AM Instructor: Alex Apotsos

GEOS 301(F) Structural Geology (Q)
The structure of the Earth's crust is constantly changing and the rocks making up the crust must deform to accommodate these changes. Rock deformation occurs over many scales ranging from individual mineral grains to mountain belts. This course deals with the geometric description of structures, stress and strain analysis, deformation mechanisms in rocks, and the large scale forces responsible for crustal deformation. The laboratories cover geologic maps and cross sections, folds and faults, stereonet analysis, field techniques, strain, and stress.
Class Format: lecture/discussion, three hours per week; laboratory, three hours per week
Requirements/Evaluation: evaluation will be based on weekly laboratory exercises, problem sets, a midterm exam, and a final exam; many of the labs and problem sets use geometry, algebra, and several projection techniques to solve common problems in structural geology
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: GEOS 101or 102, or permission of instructor
Enrollment Preferences: Geosciences majors
Enrollment Limit: 16
Expected Class Size: 12
Distributional Requirements: Division 3, Quantitative/Formal Reasoning

Fall 2016
LEC Section: 01 MW 11:00 AM 12:15 PM Instructor: Paul Karabinos

LAB Section: 02 M 01:00 PM 04:00 PM Instructor: Paul Karabinos

GEOS 302(S) Sedimentology (W)
Sediments and sedimentary rocks preserve information about the rocks that were eroded to form them, the fluids and forces that transported them, the mechanisms by which they were deposited, and the processes by which they were lithified. This course introduces the principles of sedimentology, including sediment composition, fluid mechanics, bedform analysis, and depositional environments.
Class Format: lecture/discussion, three hours per week; laboratory, three hours per week; two half-day and one all-day field trip
Requirements/Evaluation: eight written critiques (each 350-400 words) of assigned papers from the sedimentological literature—designed to teach clear written expression & careful analytical reading; evaluation based on lab work, writing assignments, hour exam & final exam
Extra Info: papers will be thoroughly edited for style, grammar and syntax; each student will compile his/her papers as a growing body of work, and each new paper will be read and edited in the context of the previous submissions
may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: GEOS 202 (may be taken concurrently with permission of instructor)
Enrollment Limit: 12
Expected Class Size: 12

Distributional Requirements: Division 3, Writing Intensive
Other Attributes: MAST Interdepartmental Electives

Spring 2017
LEC Section: 01 TR 11:20 AM 12:35 PM Instructor: Ronadh Cox

LAB Section: 02 R 01:00 PM 04:00 PM Instructor: Ronadh Cox

GEOS 303(F) Igneous and Metamorphic Petrology
Using plate tectonics and the geologic assembly of New England as a template, this course explores the origin of crystalline rocks—volcanic, plutonic, and metamorphic—that comprise 94% of the Earth's crust. Field and lab studies are the crux of the course, supported by experimental work and thermodynamic principles. Chemical and mineralogical compositions and rock fabrics provide evidence for crystallization environments and tectonic settings, past and present.
Class Format: lecture/discussion, three hours per week; laboratory, three hours per week; several field trips including one full day trip to central New Hampshire
Requirements/Evaluation: evaluation will be based on lab work, one hour test, and a final exam
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: GEOS 202 or permission of instructor
Enrollment Limit: none
Expected Class Size: 8
Distributional Requirements: Division 3

Fall 2016
LEC Section: 01 MWF 08:30 AM 09:45 AM Instructor: Bud Wobus

LAB Section: 02 W 01:00 PM 04:00 PM Instructor: Bud Wobus

GEOS 401(F) Global Tectonics and the Rise of Mountains
Fifty years after the sea-floor spreading hypothesis was first verified using magnetic anomalies, we have spectacular data sets from paleomagnetism, seismology, volcanism, the Global Positioning System, and digital elevation models that provide rich details into the kinematics and mechanisms of present and past plate motions. After an introduction to the theory of plate tectonics, local field trips will illustrate how field observations can be used to reconstruct tectonic environments in ancient mountain belts. Digital elevation models integrated with geologic maps and cross-sections will be used to construct 3D models. We will also explore ways in which tectonics, climate, and erosion affect each other during the evolution of mountain ranges. Class meetings will include lectures and discussions of assigned reading. Labs will include field trips and computer-based projects.
Class Format: lecture/discussion, three hours per week; laboratory, three hours per week; six field trips including one all-day trip
Requirements/Evaluation: participation during class and field trip discussions; six lab reports based on field trips, one computer based laboratory project, 2 four page papers based on journal articles.
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: GEOS 301 or 303 or permission of instructor
Enrollment Preferences: senior Geosciences majors
Distributional Requirements: Division 3

Fall 2016
LEC Section: 01 TR 11:20 AM 12:35 PM Instructor: Paul Karabinos

LAB Section: 02 R 01:00 PM 04:00 PM Instructor: Paul Karabinos

GEOS 405 Geochemistry: Understanding Earth's Environment
Crosslistings: GEOS 405/ENVI 405
Primary Crosslisting
Rocks, water, air, life: what comprises these interconnected components of the Earth system? How do they interact today, and how did these interactions differ in the past? In this course we will study how chemical elements are distributed in the Earth, cycle through the Earth system, and act together to produce a planet that is habitable. As Earth's landscapes and oceans, and the life they harbor, have evolved through time, they have left an imprint in the geological record that we can read using geochemical tools such as molecular fossils, elemental ratios, and stable and radioactive isotopes. Topics include the synthesis of elements in stars, the formation and differentiation of planet Earth; radiometric dating; the major constituents of the atmosphere, rain, rocks, rivers and the ocean; how they're linked by chemical weathering and biological activity; and reconstruction of past environments. Students will explore these topics through lecture; reading and discussing articles from the scientific literature; and collecting, analyzing and interpreting data from environmental samples.
Class Format: seminar/lab
Requirements/Evaluation: evaluation will be based on seminar discussions, papers, labs and final project
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: two 200-level GEOS courses and at least one of GEOS 302, 303 or 311; or permission of instructor
Enrollment Preferences: senior Geosciences majors
Enrollment Limit: 10
Expected Class Size: 10
Distributional Requirements: Division 3
Other Attributes: ENVI Natural World Electives, ENVS Group EB-B Electives, ENVS Group EG-C Electives

Not Offered Academic Year 2017
SEM Instructor: Mea Cook

GEOS 411(F) Geobiology
Geobiology—the study of interactions between earth and life over geologic timescales—is a new and interdisciplinary field that has grown out of exciting advances in earth and life sciences. During this course we will examine the many ways in which organisms — from bacteria to trees — have left their mark on our planet. Topics include the origin of life, the rise of oxygen in the earth's atmosphere, the evolution of biomineralization, the environmental context for animal evolution, the role of microbial communities in the earth system, the emergence of land plants, and the potential for planet-life interactions elsewhere in our solar system. Geobiology incorporates tools and ideas from geochemistry, paleontology, microbiology, and sedimentology. Class time will be divided between lectures and student-led discussions of primary literature. Labs will be varied and involve everything from growing our own microbial ecosystems to querying online databases and analyzing geological, geochemical, genetic, and paleontological data. Our field trip will take us to Harvard and MIT where we will tour labs doing cutting-edge geobiology research. The final project will involve writing a proposal in small groups on a geobiological topic based on the style and format of a National Science Foundation grant, and presenting the idea to the class.
Class Format: seminar; two lecture/seminars a week plus a lab
Requirements/Evaluation: labs, short papers, final grant proposal and presentation
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Prerequisites: GEOS 212; or GEOS 101 + any 200-level GEOS course; or permission of instructor
Enrollment Preferences: Senior Geoscience majors
Enrollment Limit: 15
Expected Class Size: 10
Distributional Requirements: Division 3

Fall 2016
SEM Section: 01 TR 09:55 AM 11:10 AM Instructor: Phoebe Cohen

LAB Section: 02 R 01:00 PM 04:00 PM Instructor: Phoebe Cohen

GEOS 493(F) Senior Thesis: Geosciences
Geosciences senior thesis.
Class Format: independent study
Extra Info: this is part of a full-year thesis (493-494)
may not be taken on a pass/fail basis; not available for the fifth course option
Distributional Requirements: Division 3

Fall 2016
HON Section: 01 TBA Instructor: Ronadh Cox

GEOS 494(S) Senior Thesis: Geosciences
Geosciences senior thesis.
Class Format: independent study
Extra Info: this is part of a full-year thesis (493-494)
may not be taken on a pass/fail basis; not available for the fifth course option
Distributional Requirements: Division 3

Spring 2017
HON Section: 01 TBA Instructor: Ronadh Cox

GEOS 497(F) Independent Study: Geosciences
Geosciences independent study.
Class Format: independent study
Requirements/Evaluation: may not be taken on a pass/fail basis; not available for the fifth course option
Distributional Requirements: Division 3

Fall 2016
IND Section: 01 TBA Instructor: Ronadh Cox

GEOS 498(S) Independent Study: Geosciences
Geosciences independent study.
Class Format: lecture/discussion
Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option
Distributional Requirements: Division 3

Spring 2017
IND Section: 01 TBA Instructor: Ronadh Cox