EARTH AND ENVIRONMENTAL SCIENCES

The Earth and Environmental Sciences Department (E&ES) at Wesleyan University covers many aspects of the natural world, on Earth and on other planets. Course topics range from active volcanoes to climate change to eco-conservation. The E&ES major is designed to prepare students for graduate school, as well as provide a basis for a variety of careers in the private or public sectors. Courses in geology, environmental science/environmental chemistry, environmental science/ecology, and planetary geology lead to different areas of specialization and career options.

Many E&ES students work with faculty on research projects that range from climate studies to active volcanoes in the Andes, from the structure of the Grand Canyon to the structure of the planet Venus, from nearby coastal areas (Long Island Sound) to faraway lagoons (Vieques Island, Puerto Rico). The culmination of the major is a capstone course where students perform independent research in the field (Puerto Rico, Death Valley, the Connecticut River Valley, or Hawaii).

FACULTY

Barry Chernoff
BS, SUNY at Stony Brook; MS, Adelphi University; PHD, University of Michigan
Robert Schumann Professor of Environmental Studies; Professor of Earth and Environmental Sciences; Professor of Biology; Chair, Environmental Studies Program; Director, College of the Environment; Professor, Environmental Studies

Kim Diver
BA, Carthage College; MA, Syracuse University; PHD, Syracuse University
Associate Professor of the Practice in Earth and Environmental Sciences

Martha S. Gilmore
BA, Franklin & Marshall; MSC, Brown University; PHD, Brown University
George I. Seney Professor of Geology; Professor of Earth and Environmental Sciences; Director, Graduate Studies; Co-Coordinator, Planetary Science

James P. Greenwood
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Timothy C.W. Ku
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BA, Oberlin College; MS, SUNY at Albany; PHD, Columbia University
Professor of Earth and Environmental Sciences; Professor, Integrative Sciences

Phillip G. Resor
AB, Dartmouth College; MS, University of Wyoming; PHD, Stanford University
Associate Professor of Earth and Environmental Sciences; Associate Professor, Education Studies

Dana Royer
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Professor of Earth and Environmental Sciences; Professor, Environmental Studies

BS, University of Utrecht; MS, University of Utrecht; PHD, University of Utrecht
Harold T. Stearns Professor of Earth Science; Smith Curator of Mineralogy and Petrology of the Joe Webb Peoples Museum of Natural History; Professor of Earth and Environmental Sciences; Professor, Environmental Studies; Professor, Latin American Studies

AFFILIATED FACULTY

Ellen Thomas
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Harold T. Stearns Professor of Integrative Sciences; Smith Curator of Paleontology of the Joe Webb Peoples Museum of Natural History; University Professor in the College of Integrative Sciences; Research Professor, Earth and Environmental Sciences

VISITING FACULTY

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BA, Ricker College; MA, Wesleyan University; PHD, Columbia University
Visiting Scholar in Earth Environmental Sciences

EMERITI

James T. Gutmann
BA, Amherst College; MAA, Wesleyan University; PHD, Stanford University
Professor of Earth and Environmental Sciences, Emeritus

Peter C. Patton
BA, Franklin & Marshall; MAA, Wesleyan University; MS, Colorado St University; PHD, University of Texas Austin
Alan M. Dachs Professor of Science, Emeritus

UNDERGRADUATE PROGRAM

DEPARTMENTAL ADVISING EXPERTS

All program faculty

- Undergraduate Earth and Environmental Sciences Major (catalog.wesleyan.edu/departments/ees/ugrd-ees/)
- Master of Arts in Environmental Sciences (catalog.wesleyan.edu/departments/ees/grad-ees/)

E&ES101 Dynamic Earth

The earth is a dynamic planet, as tsunamis, hurricanes, earthquakes, and volcanic eruptions make tragically clear. The very processes that lead to these natural disasters, however, also make life itself possible and create things of beauty and wonder. In this course we will study the forces and processes that shape our natural environment, as well as the effect we have on this world. Topics range in scale from the global pattern of mountain ranges to the atomic structure of minerals and in time from billions of years of Earth history to the few seconds it takes for a fault to slip during an earthquake. Hands-on activities and short field trips complement lectures to bring the material to life—so put on your hiking boots and get ready to explore our planet.

Offering: Host
Grading: A-F
Credits: 1.25
Gen Ed Area: NSM-EES
Prereq: None

E&ES102Z Natural History of the Connecticut River Valley

Please note: Readings and assignments will be due during winter break, prior to arriving on campus for Winter Session. Please visit the Winter Session website for the full syllabus -- http://www.wesleyan.edu/wintersession.

What did Middletown look like 200 million years ago? What about 20,000 years ago, or 200 years ago? The natural history of Middletown and the broader Connecticut River valley is a rich tapestry. In this course, we will explore some of its major threads, including the geologic, glacial, Native American, early European, and industrial histories. The primary goal of the course is to deepen your sense of place for this valley that you call home during your four years at Wesleyan. The majority of the class time will be spent visiting sites in the valley, both indoor and outdoor. You must be prepared to spend multiple hours outside, including walking up to two miles. The presence of snow may cause some trips to be postponed or cancelled. To remain flexible for these possible contingencies, students should keep the entire January 7-21 block open in their schedules.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES111F As the World Turns - Earth History, with Life's Ups and Downs (FYS)

An introduction to the major events that shaped our modern Earth over the 4.5-billion-year history of our planet. We discuss the composition of the early atmosphere devoid of oxygen, the great oxygenation event related to the emergence of cyanobacteria, snowball Earth, origin and evolution of life prior to 500 million years ago, and then a treatment of the major asteroid impacts, mega-volcanic periods, and other disasters that catastrophically modified the Earth and influenced all that lived on it. We close with possibly the biggest disaster of them all: the human era, with the climate crisis, pollution, and possibly the largest extinction event ever? We use the Earth and environmental sciences, astronomy, and the basic sciences to introduce and explain the processes that ultimately shaped our modern world.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES115 Introduction to Planetary Geology

This course will examine the workings of Earth and what we can learn from examining Earth in the context of the solar system. Comparative planetology will be used to explore such topics as the origin and fate of Earth, the importance of water in the solar system, the formation and maintenance of planetary lithospheres and atmospheres, and the evolution of life. Exercises will utilize data from past and present planetary missions.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES125 Black Speculative Fictions and the Anthropocene

The genre of black speculative fiction--in the form of literature, art, music, and theory--provides a generative framework through which to (re)think understandings of race, gender, sexuality, class, the body, disability, citizenship, and the human. Often couched as taking place in the ‘future,’ black speculative fictions also engage the past and critique the present. This makes the genre a critical resource for addressing the Anthropocene. The term ‘Anthropocene’ first emerged from the discipline of geology in 2000. Scientists proposed that Earth had entered a new epoch (following the Holocene) in which ‘humans’ had become geological forces, impacting the planet itself. However, the term Anthropocene raises numerous questions. What does it mean to think about the human at the level of a ‘species’? What constitutes evidence of the Anthropocene and when did it begin? Who is responsible for the Anthropocene’s attendant catastrophes, which include earthquakes, altered ocean waters, and massive storms? Does the Anthropocene overemphasize the human and thus downplay other interspecies and human-nonhuman, animate-inanimate relations? Or does it demand a (potentially fruitful) reconceptualization of the human? Further, how does artificial intelligence complicate definitions of the human and, by extension, of the Anthropocene? Centering the work of black speculative thinkers and placing it in conversation with scientific studies ranging from marine biology and geology to cybernetics, this course takes an interdisciplinary approach to the Anthropocene that endeavors to (re)conceptualize the human, ecological relations, and Earth itself. Texts engaged will include: novels, art, music, theory, and scientific studies.

Offering: Cross listing
Grading: A-F
Credits: 1.00
Gen Ed Area: HA-CHUM
Identical With: CHUM302, AFAM312, FGSS301
Prereq: None

E&ES130F Digital Storytelling with Maps: Science Stories (FYS)

Digital storytelling describes the practice of using digital tools to tell a ‘story’ in an engaging and compelling format. A story map is a digital storytelling tool that combines maps with multimedia content (e.g., images, video, text) to convey geographic information as a narrative. In this course, students will employ elements of cartographic design, spatial analysis, and data visualization within story maps as a means for creating interactive ‘stories’ about empirical scientific data. (No prior experience with web maps or story maps is required.) Students will explore multiple story map formats and their utility in the effective communication of science to scientists, the public, and policy makers.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: None
Prereq: None

E&ES151 The Planets

More than 300 planets are now known in the universe, eight of which circle the sun. NASA missions and improved telescopes and techniques have greatly increased our knowledge of them and our understanding of their structure and evolution. In this course, we study those eight planets, beginning with the pivotal role that they played in the Copernican revolution, during which the true nature of the Earth as a planet was first recognized. We will study the geology of the Earth in some detail and apply this knowledge to our closest planetary neighbors--the moon, Venus, and Mars. This is followed by a discussion of the giant planets and their moons and rings. We will finish the discussion of the solar system with an examination of planetary building blocks--the meteorites, comets, and asteroids. Additional topics covered in the course include spacecraft exploration, extrasolar planetary systems, the formation of planets, life in the universe, and the search for extraterrestrial intelligence.

Offering: Host
Grading: A-F
Credits: 1.25
Gen Ed Area: NSM-EES
Identical With: ASTR103
Prereq: None

E&ES155 Earth System Science

An introduction to Earth system science intended for students pursuing the Earth and environmental sciences major and others with good high school math and science preparation. Earth system science integrates chemistry, physics, biology and geology to understand the Earth as an integrated planetary
E&ES197 Introduction to Environmental Science and Sustainability

Earth’s natural systems have operated for billions of years but are now severely altered by human activity. The rate of environmental change caused by humans is unprecedented. This course is designed to help students explore the science behind four interrelated environmental areas; water, energy, food and climate change. We will explore some of the basic principles of atmospheric science, ecology, environmental chemistry, geosciences, and hydrology.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES160 Life in the Oceans in the Anthropocene and Beyond

Little is known about life in the deep sea, the largest habitat on Earth, even about the largest animals living there, such as the giant squid. Humans, however, are severely affecting even these most remote areas of our planet, and wildlife populations in the oceans have been badly damaged by human activity. We will look at the amazing diversity of ocean life and the disparate building plans of its animals, and see how oceanic ecosystems are fundamentally different from land ecosystems. Then we will explore how human actions are affecting oceanic ecosystems directly, for instance by overfishing (especially of large predators and filter feeders), addition of nutrients (eutrophication) and pollutants, and the spread of invasive species, as well as indirectly, through emission of carbon compounds into the atmosphere. Rising atmospheric CO2 levels lead to ocean acidification and global warming, affecting the all-important metabolic rates of ocean life, as well as oceanic oxygen levels and stratification, thus productivity. We will try to predict the composition of future ecosystems by looking at ecosystem changes during periods of rapid warming in the geological past and see whether future ecosystems will become dominated by jellyfish, as they were 600 million years ago.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: CIS160, BIOL160
Prereq: None

E&ES195 Sophomore Field Course

This course is designed for sophomores who have declared a major in earth and environmental sciences. The course will give students a common experience and a more in-depth exposure to the department prior to their junior year. Students will be exposed to the wide variety of geological terrains and ecological environments of southern New England.

Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-EES

Prereq: None

E&ES197 Introduction to Environmental Studies

This interdisciplinary study of human interactions with the environment and the implications for the quality of life examines the technical and social causes of environmental degradation at local and global scales, along with the potential for developing policies and philosophies that are the basis of a sustainable society. This will include an introduction to ecosystems, climatic and geochemical cycles, and the use of biotic and abiotic resources over time. It includes the relationship of societies and the environment from prehistoric times to the present. Interrelationships, feedback loops, cycles, and linkages within and among social, economic, governmental, cultural, and scientific components of environmental issues will be emphasized.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: BIOL197, ENVS197
Prereq: None

E&ES215 Earth Materials

This course introduces students to the solid, natural, and nonbiological materials that make up our world. We will cover the fundamentals of mineralogy and the...
petrology of igneous, metamorphic, and sedimentary rocks. We will also discuss materials that are used by humans and form the basis of societies.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES216 Earth Materials Laboratory
This course will introduce students to laboratory techniques used in identifying and understanding rocks, minerals, and other Earth materials.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: None

E&ES220 Geomorphology
This inquiry into the evolution of the landscape emphasizes the interdependence of climate, geology, and physical processes in shaping the land. Topics include weathering and soil formation, fluvial processes, and landform development in cold and arid regions on Earth and other planets. Applications of geomorphic research and quantitative theories of landform development are introduced throughout the course where appropriate.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: E&ES101 OR E&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197]

E&ES221 Geomorphology Laboratory
This course will introduce various methods of measuring landforms in the field, including stream measurement, hazard assessment, and the classification of glacial, volcanic, coastal, and tectonic features. The course includes laboratory exercises in the utilization of topographic maps, aerial photographs, and various remote-sensing techniques. This will include field trips to various locations in CT.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: E&ES101 OR E&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197]

E&ES222 Structural Geology
Structural geology is the study of the physical evidence and processes of rock deformation, including jointing, faulting, folding, and flow. Geologic structures can be used to interpret tectonic history and understand physical processes responsible for geologic hazards such as earthquakes, volcanoes, and landslides. Many structures also exert a primary control on fluid flow in the earth’s crust and thus play an important role in determining the distribution of natural resources and environmental contaminants.

In this course students will learn the theoretical foundations, observational techniques, and analytical methods used in modern structural geology. Case studies are drawn from local field work (see description of E&ES224) and published data sets from around the world.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: E&ES101 OR E&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197]

E&ES224 Field Geology
This course is designed to provide students with a basic understanding of geological principles in the field. Emphasis will be on describing, measuring, and mapping bedrock geology and structures with applications to tectonics, mountain building, earthquake science, volcanology, and groundwater hydrology.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: E&ES197 or BIOL197

E&ES230 Sedimentology
Sedimentary geology impacts many aspects of modern life. It includes the study of sediment formation, erosion, transport, deposition, and the chemical changes that occur thereafter. It is the basis for finding fossil fuels, industrial aggregate, and other resources. The sedimentary record provides a long-term history of biological evolution and of processes such as uplift, subsidence, sea-level fluctuations, climate change, and the frequency and magnitude of earthquakes, storms, floods, and other catastrophic events. This class will examine the origin and interpretation of sediments, sedimentary rocks, fossils, and trace fossils. Students must take E&ES231 Sedimentology/Stratigraphy Techniques concurrently.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: E&ES101 OR E&ES199 OR [E&ES197 or BIOL197 or ENVS197] OR E&ES199

E&ES231 Sedimentology/Stratigraphy Techniques
This course provides macroscopic and microscopic inspection of sedimentary rocks. It will include field trips, experiments, and laboratory analyses. There will be an optional weekend field trip and there may be one daylong industry event. E&ES230 must be taken concurrently.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: None

E&ES234 Geobiology
Fossils provide a glimpse into the form and structure of ancient ecosystems. Geobiology is the study of the two-way interactions between life (biology) and rocks (geology); typically, this involves studying fossils within the context of their sedimentary setting. In this course we will explore the geologic record of these interactions, including the fundamentals of evolutionary patterns, the origins and evolution of early life, mass extinctions, and the history of the impact of life on climate.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: BIOL233, ENVS233
Prereq: E&ES101 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197]

E&ES235 Geobiology Laboratory
This laboratory course will explore more deeply some of the concepts introduced in E&ES234. Both the fundamental patterns and practical applications of the fossil record will be emphasized.

Offering: Host
Grading: A-F
E&ES238 The Forest Ecosystem
This course examines basic ecological principles through the lens of forest ecosystems, exploring the theory and practice of forest ecology at various levels of organization from individuals to populations, communities, and ecosystems. Lectures, lab exercises, and writing-intensive assignments will emphasize the quantification of spatial and temporal patterns of forest change at stand, landscape, and global scales.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL346, BIOL546, E&ES538, ENVS340
Prereq: [BIOL182 or MB&B182] OR [E&ES197 or BIOL197 or ENVS197] OR E&ES199

E&ES240 Invasive Species: Biology, Policy, and Management
Invasive species account for 39 percent of the known species extinctions on Earth, and they are responsible for environmental damages totaling greater than $138 billion per year. However, the general population has little knowledge of what invasive species are or what threats they pose to society. In this course, we will explore the biological, economic, political, and social impacts of invasive species. We will begin by exploring a definition of an invasive species and looking at the life history characteristics that make them likely to become pests. Then we will consider the effects of invasive species expansion on the conservation of biodiversity and ecosystem function, as well as their global environmental and political impacts. Finally, we will explore the potential future changes in invasive species distributions under a changing climate.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL226, ENVS226
Prereq: [E&ES197 or BIOL197 or ENVS197] OR [BIOL182 or MB&B182] OR E&ES199

E&ES244 Soils
Soils represent a critical component of the world’s natural capital and lie at the heart of many environmental issues. In this course we will explore many aspects of soil science, including the formation, description, and systematic classification of soils; the biogeochemical cycling of nutrients through soil systems; and the issues of soil erosion and contamination.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EEES
Prereq: E&ES101 OR E&ES115 OR E&ES199 OR E&ES197 OR BIOL197 or ENVS197

E&ES245 Soils Laboratory
This course will explore more deeply the concepts introduced in E&ES244 in a laboratory setting. Emphasis will be placed on the analysis of soil profiles both in the field and in the laboratory.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EEES
Prereq: E&ES101 OR E&ES197 OR BIOL197 or ENVS197 OR E&ES199 OR [BIOL182 or MB&B182]

E&ES246 Hydrology
This course is an overview of the hydrologic cycle and man’s impact on this fundamental resource. Topics include aspects of surface-water and groundwater hydrology as well as discussion about the scientific management of water resources. Students will become familiar with the basic concepts of hydrology and their application to problems of the environment.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EEES
Identical With: E&ES246
Prereq: E&ES101 OR E&ES115 OR E&ES197 OR BIOL197 or ENVS197 OR E&ES199

E&ES247 Hydrology Laboratory
The lab will consist of field trips to local streams to observe the geomorphic processes related to stream channel and floodplain formation and the effects of urbanization on stream channels. Other labs will involve the analysis of hydrologic data through the use of statistical analysis and hydrologic modeling.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EEES
Prereq: None

E&ES248 Environmental Investigation and Remediation
This course will cover environmental investigation and remediation methods in varying geologic settings and how they have changed over time due to regulatory changes and advances in technology. An introduction to various aspects of environmental consulting will be incorporated throughout the term using case studies, guest lecturers, and emerging trends and research from online sources.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EEES
Identical With: ENVS248
Prereq: E&ES101 OR E&ES115 OR E&ES199 OR E&ES197

E&ES250 Environmental Geochemistry
A qualitative and quantitative treatment of chemical processes in natural systems such as lakes, rivers, groundwater, the oceans, and atmosphere. General topics include equilibrium thermodynamics, acid-base equilibria, the carbonic acid system, oxidation-reduction reactions in nature, and isotope geochemistry. If offered, the associated lab course (E&ES 251) must be taken concurrently. The lab course is usually taught as a service-learning course in which students work with a community organization to solve an environmental problem. Previous classes have evaluated the energy potential of a local landfill and investigated the cause and possible remediation of local eutrophic lakes.
There are no official prerequisites but students should be comfortable with chemical concepts or should have taken introductory college chemistry or advanced high school chemistry courses.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EEES
Identical With: ENVS250
Prereq: None

E&ES251 Environmental Geochemistry Laboratory
This course will supplement E&ES 250 by providing students with hands-on experience of the concepts taught in E&ES 250. The course will emphasize the field collection, chemical analysis, and data analysis of environmental water, air, and rock samples. This course is often taught as service-learning course where the class works with a community organization to solve an environmental
problem. The course usually concludes with a public presentation of the work. Past service-learning projects have examined landfills, damned rivers, and polluted lakes.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Identical With: ENVS281
Prereq: None

E&ES257 Environmental Archaeology
Archaeological materials provide long-term records of how humans have modified past environments and how human societies respond to environmental change. In this course, students will learn how data from ancient plants, animals, and soils can be analyzed in order to draw interpretations about past human-environmental interactions. We will also discuss key topics in environmental archaeology, including the long-term environmental impacts of plant and animal domestication and debates over environmental causes for the ‘collapse’ of civilizations such as the ancient Maya. The course will involve hands-on preparation of plant and animal specimens to add to the Wesleyan Environmental Archaeology Laboratory comparative collections. Students must be available on Sunday, March 1, for the first stage of animal skeleton preparation.

Offering: Crosslisting
Grading: OPT
Credits: 1.00
Gen Ed Area: SBS-ARCP
Identical With: ARCP257, ENVS257, ANTH257
Prereq: None

E&ES260 Oceans and Climate
Earth’s climate is not static. Even without human intervention, the climate has changed. In this course we will study the major properties of the ocean and its circulation and changes in climate. We will look at the effects of variations in greenhouse gas concentrations, the locations of continents, and the circulation patterns of oceans and atmosphere. We will look at these variations on several time scales. For billions of years, the sun’s energy, the composition of the atmosphere, and the biosphere have experienced changes. During this time, Earth’s climate has varied from much hotter to much colder than today, but the variations were relatively small when compared to the climate on our neighbors Venus and Mars. Compared with them, Earth’s climate has been stable; the oceans neither evaporated nor froze solid. On shorter time scales, different processes are important. We will look at these past variations in Earth’s climate and oceans and try to understand the implications for possible climates of the future.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: ENVS290, E&ES560
Prereq: E&ES101 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197]

E&ES261 Techniques in Ocean and Climate Investigations
Weekly and biweekly field trips, and computer and/or laboratory exercises will allow us to see how climate and oceans function today and in the past. In addition to our data, we will most likely use the Goddard Institute for Space Studies climate model to test climate questions and data from major core (ocean, lake, and ice) repositories to investigate how oceans and climate function and have changed.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES

E&ES270 Quantitative Methods for the Biological and Environmental Sciences
This course offers an applied approach to statistics used in the biological, environmental, and earth sciences. Statistics will be taught from a geometric perspective so that students can more easily understand the derivations of formulae. We will learn about deduction and hypothesis testing as well as the assumptions that methods make and how violations affect applied outcomes. Emphasis will be on analysis of data, and there will be many problem sets to solve to help students become fluent with the methods. The course will focus on data and methods for continuous variables. In addition to basic statistics, we will cover regression, ANOVA, and contingency tables.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL242, BIOL542, E&ES570, ENVS242
Prereq: None

E&ES280 Introduction to GIS
Geographical information systems (GIS) are powerful tools for organizing, analyzing, and displaying spatial data. GIS has applications in a wide variety of fields including the natural sciences, public policy, business, and the humanities—literally any field that uses spatially distributed information. In this course we will explore the fundamentals of GIS with an emphasis on practical application of GIS to problems from a range of disciplines. The course will cover the basic theory of GIS, data collection and input, data management, spatial analysis, visualization, and map preparation. Coursework will include lecture, discussion, and hands-on activities.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES580
Prereq: None

E&ES281 GIS Service-Learning Laboratory
This course supplements E&ES280 by providing students the opportunity to apply GIS concepts and skills to solve local problems in environmental sciences. Small groups of students will work closely with community groups to design a GIS, collect and analyze data, and draft a professional-quality report to the community.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Identical With: E&ES581
Prereq: None

E&ES301 New England Geology
For more than a century, students and professionals interested in the geology of New England have gathered at the annual meeting of the New England Intercollegiate Geologic Conference (NEIGC), a weekend of field-based education. In this seminar, we will choose three NEIGC fieldtrips to attend, study the appropriate background material in preparation for the trips, and compile our own guide to the trips that summarizes the appropriate background material. The class will culminate in attendance at the annual NEIGC meeting on the weekend of October 12-14, 2018 in the Lake George region of Upstate New York and Vermont.

At the end of this course, you will not only know a lot more about New England geology and have met many current and future field geologists, but you will also have learned to synthesize the literature to assess the current state of
knowledge and evaluate how field studies can advance our understanding of regional geology and environmental issues.

Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: None

E&ES306 Ecology and Natural History of Freshwater Fishes of South America
South America has the highest diversity of freshwater fishes anywhere in the world. In fact, there are more than twice the number of mammals and about the same number of birds in the world. Why has this remarkable radiation occurred in such a relatively short period of time? How can so many fishes coexist in the same rivers, utilizing the same resources? In this intensive course, we will travel to Colombia during spring break (March 7–21) in order to gain firsthand knowledge about the ecology and natural history of freshwater fishes in South America. We will learn about the ecological and environmental factors that contribute to perhaps the largest biological radiation on the planet.

Students will obtain firsthand experience with the South American tropics, freshwater fishes, and with doing experiments in the field. Each day there will be a combination of lectures and field or laboratory exercises. We will travel to and explore fish ecology in different types of rivers at different elevations. Students will gather and analyze data about biological, physical, and environmental issues that are covered in the lectures. The habitats that we will explore will be both terrestrial and freshwater rivers. Our base will be at the Instituto Humboldt in Villa de Leyva, Colombia. We will interact with Colombian students who are studying ecology and biodiversity at the Institute in order to exchange ideas about current environmental issues.

All the costs of travel, lodging, and meals will be covered by the course.

Offering: Crosslisting
Grading: A-F
Credits: 1.50
Gen Ed Area: None
Identical With: ENVS306, BIOL306
Prereq: None

E&ES313 Petrogenesis of Igneous and Metamorphic Rocks
This course studies the occurrence and origin of volcanic, plutonic, and metamorphic rocks and how to read the record they contain. Topics will include the classification of igneous and metamorphic rocks, but emphasis will be on the geological, chemical, and physical processes taking place at and beneath volcanoes, in the earth’s mantle, and within active orogenic belts.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES13
Prereq: E&ES213 OR E&ES215

E&ES314 Laboratory Study of Igneous and Metamorphic Rocks
This lab course focuses on the recognition and study of volcanic, plutonic, and metamorphic rocks in hand specimen and in thin section.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: (E&ES213 AND E&ES215)

E&ES317 Volcanology
Volcanic eruptions, among the most impressive natural phenomena, have been described throughout history. In this course, we will look at the physical and chemical processes that control volcanic eruptions and their environmental impacts. We also examine the direct impact on humanity, ranging from destructive ashfalls to climate change, and the benefits of volcanoes for society (e.g., geothermal energy, ore deposits).

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES317
Prereq: E&ES101 OR E&ES213 OR E&ES215

E&ES319 Meteorites and Cosmochemistry
This course will focus on the materials in the world’s collection of extraterrestrial samples and what they tell us about Earth, our nearest planetary neighbors, and the origin of our solar system. Planetary geochemical processes will be discussed through the examination of samples from comets, asteroids, Mars, the moon, Vesta, and Earth. Other topics covered will be impact cratering and the delivery of meteorites to Earth. Meteorites teach us about the earliest history of planet formation in this solar system, and we will compare this to what is observed in other solar systems. The course is intended for majors and graduate students in Wesleyan’s Natural Science and Mathematics (NSM) division.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Identical With: E&ES319
Prereq: None

E&ES320 Meteorites Laboratory
This will be the lab component of E&ES319 Meteorites and Cosmochemistry and must be taken concurrently. This class will be primarily hands-on learning using extraterrestrial materials and their terrestrial analogs.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Identical With: E&ES320
Prereq: None

E&ES321 Planetary Evolution
Why are we the only planet in the solar system with oceans, plate tectonics, and life? This course examines how fundamental geologic processes operate under the unique conditions that exist on each planet. Emphasis is placed on the mechanisms that control the different evolutionary histories of the planets. Much of the course will utilize recent data from spacecraft. Readings of the primary literature will focus on planetary topics that constrain our understanding of geology as well as the history and fate of our home, the Earth.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES321
Prereq: E&ES213 OR E&ES220 OR E&ES223 OR [E&ES250 or ENVS280]

E&ES325 Geologic Field Mapping
In this project-based service learning course students will learn to construct accurate large-scale (>1:24000) geologic maps (2D) and photo-realistic outcrop models (3D). They will apply these skills to make maps and models of local open-spaces to enhance recreational use and environmental education. The specific mapping technologies learned and applied will depend on the project and be determined in consultation with community partners. Methods may include GPS and/or total station surveying, structure from motion (photogrammetric) ranging, lidar data processing and analysis, drone imaging, and GIS synthesis. The instructor will introduce the theory and practice for each method used.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES

E&ES342 Ecological Resilience: The Good, the Bad, and the Mindful
This course will examine the concepts of resilience, fragility, and adaptive cycles in the context of ecosystem and social-ecological-system (SES) structures. These concepts have been developed to explain abrupt and often surprising changes in complex ecosystems and SES that are prone to disturbances. We will also include nonhierarchal interactions among components of systems (termed panarchy) to compare the interactions and dependencies of ecological and human community systems. A systems approach will be applied to thinking about restoration ecology, community reconstruction, and adaptive management theory.

All of the terms—resilience, fragility, adaptation, restoration, reconstruction—are fraught with subjectivity and valuation. We will use mindfulness and meditation techniques (including breathing and yoga) to more objectively and dynamically engage in the subject matter, leaving behind prejudice or bias. Students will be expected to approach these techniques with an open mind and practice them throughout the semester. The objective is to provide students with a more comprehensive framework with which to gain deeper understanding and integration of the science with the social issues.

Offering: Crosslisting
Grading: A-F
Credits: 1.25
Gen Ed Area: NSM-ENVS
Identical With: ENV5369
Prereq: [E&ES197 or BIOL197] OR [BIOL182 or MB&B182]

E&ES359 Global Climate Change
The climate of the earth has been changing over the course of Earth history. Over the last few decades, we have come to realize that humans may be the strongest driver of climate change in the 20th century and near future. In this class we evaluate that hypothesis in some depth, using the basic physical foundations of climate science with a focus on radiative principles. We study the details of the short carbon cycle and the empirical climate record of the last 1000 years, with data from the instrumental record, historical indicators, and physical (pollen, geochemical/isotopic temperature indicators) records. Besides the principles of fundamental climate science, we will deal with some of the results of climate change, mainly sea-level rise and feedbacks on the biosphere. We look at the impact of humans on atmospheric chemistry and how human civilization has caused changes in the carbon cycle; possibly as early as the transition period from hunter-gatherers to agricultural society. The final part of the lecture section is on future climate, using economic scenarios, mitigation and adaptation efforts, and climate/economics models.

Parallel to the lectures, several experimental projects are done by groups of students: studies with our experimental ‘analog earth’ climate model; monitoring CO2 in Middletown air for a semester; working with data from the Wesleyan weather station to calculate theoretical climate fluctuations; experimental work on the absorption of CO2 into water for the geochemically inclined; the impact of increased CO2 levels on plant growth for the biologically inclined; and a social-economic global assessment on carbon policies for the environmental studies types. In other years, students built solar ovens and a basic infrared spectrometer among projects.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES361 Living in a Polluted World
This course treats the occurrences and origins, natural pathways, toxicologies, and histories of the major environmental contaminants. We all know about lead and its effects on humans, but how about cadmium and hexachromium, or the many unpronounceable organic contaminants, usually referred to by some acronym (e.g., DDT, POPs)? We also deal with the larger topics of CO2/climate change, the environmental nitrogen-oxide balance, and eutrophication of coastal waters (the ‘dead zones’). To be effective in this course, students will need basic high school/college-level proficiency in chemistry and math as we will delve into aspects of geochemistry, geology, toxicology, environmental law, and some simple modeling. The class consists of lectures, one problem set, one Hg-in-hair class study, and a class project on lead in drinking water in the Middletown area. This is also a service-learning course, providing environmental outreach to the larger Middletown community on local pollution.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-ENVS
Identical With: ENV5361
Prereq: None

E&ES368 Isotope Geochemistry
This course explains from first principles the main stable and radioactive isotopic techniques used in biogeochemistry, environmental geochemistry, and geology. The oxygen, hydrogen, carbon, nitrogen, and sulfur stable isotope systems and the Rb-Sr, Sm-Nd, U-Th-Pb, and K-Ar radioactive systems will be discussed in detail. This course will emphasize the application of isotope techniques in hydrological, geochemical, and ecological studies.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES568
Prereq: None

E&ES375 Modeling the Earth and Environment
Models can provide insights into Earth systems that are difficult to obtain by direct experimentation or observation. This course will introduce students to the process of translating Earth systems into idealized mathematical models, specific methods for solving the resulting equations, and implementation of models in MATLAB. We will explore cases from a range of topics in the earth and environmental sciences to gain a better appreciation of the insights models can offer.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES375
Prereq: MATH118 OR MATH122

E&ES376 Mass Extinctions in the Oceans: Animal Origins to Anthropocene
Geoscientists are debating whether we are living in the Anthropocene, defined as a period during which humans are having a significant effect on atmospheric, geologic, hydrologic, and biospheric earth system processes. There is considerable discussion whether we are indeed affecting the biosphere to such an extent that life on Earth will suffer an extinction similar in magnitude to these that have occurred during earth history. Studies of the fossil record provide unique evidence that is used to evaluate the large extinctions of the past and compare them to ongoing extinction processes, extinctions rates and patterns, and magnitude. Organisms with hard skeletons are most easily and most abundantly preserved in the rock record. Many of these are invertebrates that lived in the oceans (e.g., clams, sea urchins, corals). In the first part of this course, students will become familiar with the nature of the fossil record, the most common marine animals in the fossil record, and their evolution and
E&ES380 Advanced GIS and Spatial Analyses
A geographic information system (GIS) is a powerful database that allows for the collection, manipulation, analysis, and presentation of spatially referenced data. GIS technologies facilitate science, social science, and humanities research that uses location-based data. This course will focus on individual projects conducted within a collaborative learning framework. Each student is responsible for developing and producing a semester-long project focused on advanced spatial data analyses and/or advanced cartographic design using a GIS. Students will enter the course with an individual or small team (2-3 students) project in mind, such as a component of a senior thesis, work on a faculty member’s research project, or a community-based service-learning project. Course sessions will be a mix of studio time for projects (e.g., work time, critiques), skill development (e.g., lectures, student-led skills-training sessions), and intellectual advancement (e.g., guest speakers, conference attendance).

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: QAC344, E&ES582
Prereq: QAC231 OR E&ES280

E&ES385 Remote Sensing
This course studies the acquisition, processing, and interpretation of remotely sensed images and their application to geologic and environmental problems. Emphasis is on understanding the composition and evolution of the Earth and planetary surfaces using a variety of remote-sensing techniques. This course will discuss the theory and technology behind a number of remote sensing platforms and how data at different wavelengths interacts with rocks, soils, water and vegetation. It’s powerful stuff.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: QAC344, E&ES582
Prereq: QAC231 OR E&ES280

E&ES386 Remote-Sensing Laboratory
This laboratory course includes practical application of remote-sensing techniques, primarily using computers. Exercises will include manipulation of digital images (at wavelengths from gamma rays to radar) taken from orbiting spacecraft as well as from the collection of data in the field. Students will learn the software program ENVI, a marketable skill.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES

Prereq: E&ES213 OR E&ES220 OR E&ES223 OR [E&ES234 or BIOL233 or ENV5233] OR [E&ES250 or ENV5280] OR [E&ES260 or ENV5290 or E&ES560]

E&ES399 Calderwood Seminar in Public Writing: Environmental Science Journalism
This is a seminar for science majors who want to develop skills in communicating science to non-scientists, by writing about environmental science topics. The course will concentrate on writing, public presentations and interviews. Students will read scholarly articles, interview scientists, and/or conduct independent research to write articles, essays and op-eds. Each week students will take alternating roles as writers and editors. The course is only open to science majors.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

E&ES401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

E&ES402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

E&ES407 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: Host
Grading: A-F

E&ES408 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: Host
Grading: A-F

E&ES409 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: A-F

E&ES410 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: A-F

E&ES411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

E&ES412 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

E&ES419 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.

Offering: Host
Grading: Cr/U

E&ES420 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
oral presentations and written reports. In groups, students will develop original, hypothesis-driven research projects to be implemented in E&ES 498. The goal of the course is to help students transition to independent, professional scientists.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Prereq: None

E&ES498 Senior Field Research Project

This course is for E&ES majors who have completed E&ES497 Senior Seminar and focuses on improving scientific research skills. The optional research excursion will be taught during the month of January at a designated field area. Past classes have conducted research in Death Valley, California, the main island of Puerto Rico, the Connecticut River Valley, and the Big Island of Hawaii. In January and throughout the third quarter, students will execute the research projects developed in E&ES497 Senior Seminar. This course will conclude with student group presentations and written reports.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Prereq: None

E&ES500 Graduate Pedagogy

The elements of good teaching will be discussed and demonstrated through lectures, practice teaching sessions, and discussions of problems encountered in the actual teaching environment. The staff consists of faculty and experienced graduate students. An integral part of the course is a required one-day workshop BEFORE the first day of formal classes.

Training in pedagogy in the first semester of attendance is required for all incoming Wesleyan MA and PhD students who have not already fulfilled this requirement at Wesleyan. BA/MA students are not required to get training in pedagogy but may choose to do so.

Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: None
Identical With: CHEM500, BIOL500, ASTR500, MB&B500, MUSC500, PHYS500, PSYC500, MATH500
Prereq: None

E&ES501 Individual Tutorial for Graduate Students

Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

E&ES502 Individual Tutorial, Graduate

Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

E&ES503 Selected Topics, Graduate Sciences

Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.

Offering: Host
Grading: OPT

E&ES513 Petrogenesis of Igneous and Metamorphic Rocks

This course studies the occurrence and origin of volcanic, plutonic, and metamorphic rocks and how to read the record they contain. Topics will include the classification of igneous and metamorphic rocks, but emphasis will be on the geological, chemical, and physical processes taking place at and beneath volcanoes, in the earth’s mantle, and within active orogenic belts.

Offering: Crosslisting
E&ES319 Meteorites and Cosmochemistry
This course will focus on the materials in the world's collection of extraterrestrial samples and what they tell us about Earth, our nearest planetary neighbors, and the origin of our solar system. Planetary geochemical processes will be discussed through the examination of samples from comets, asteroids, Mars, the moon, Vesta, and Earth. Other topics covered will be impact cratering and the delivery of meteorites to Earth. Meteorites teach us about the earliest history of planet formation in this solar system, and we will compare this to what is observed in other solar systems. The course is intended for majors and graduate students in Wesleyan's Natural Science and Mathematics (NSM) division.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES319
Prereq: None

E&ES520 Meteorites Laboratory
This will be the lab component of E&ES319 Meteorites and Cosmochemistry and must be taken concurrently. This class will be primarily hands-on learning using extraterrestrial materials and their terrestrial analogs.
Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Identical With: E&ES320
Prereq: None

E&ES213 OR E&ES220 OR E&ES223 OR [E&ES250 or ENVS280]

E&ES546 Hydrology
This course is an overview of the hydrologic cycle and man's impact on this fundamental resource. Topics include aspects of surface-water and groundwater hydrology as well as discussion about the scientific management of water resources. Students will become familiar with the basic concepts of hydrology and their application to problems of the environment.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL346, BIOL546, E&ES238, ENVS340
Prereq: [BIOL182 or M&B&B182] OR [E&ES197 or BIOL197 or ENVS197] OR E&ES199

E&ES538 The Forest Ecosystem
This course examines basic ecological principles through the lens of forest ecosystems, exploring the theory and practice of forest ecology at various levels of organization from individuals to populations, communities, and ecosystems. Lectures, lab exercises, and writing-intensive assignments will emphasize the quantification of spatial and temporal patterns of forest change at stand, landscape, and global scales.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL346, BIOL546, E&ES238, ENVS340
Prereq: [BIOL182 or M&B&B182] OR [E&ES197 or BIOL197 or ENVS197] OR E&ES199

E&ES549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

E&ES550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

E&ES555 Planetary Science Seminar
This course will examine topics and methods in the interdisciplinary field of planetary science. Students will join several faculty members in the planetary science group to discuss the origin, evolution, and habitability of planets in this and other solar systems. This class is intended for graduate students who are pursuing or mean to pursue the planetary science concentration. Other graduate and undergraduate students may request admission to the course.
E&ES577 Research Discussion in Earth & Environmental Sciences
This course focuses on the specific research projects of individual graduate students in the E&ES department, and it comprises student presentations and discussion, including the department faculty and graduate students. The course offers a forum for presenting new results and exploring new ideas, as well as for providing researchers with feedback and suggestions for solving methodological problems. It also provides an opportunity for graduate students in the program to become familiar with the wide range of research taking place in the department. This course may be repeated for credit.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: NSM-EES
Identical With: ASTR555
Prereq: None

E&ES560 Oceans and Climate
Earth’s climate is not static. Even without human intervention, the climate has changed. In this course we will study the major properties of the ocean and its circulation and changes in climate. We will look at the effects of variations in greenhouse gas concentrations, the locations of continents, and the circulation patterns of oceans and atmosphere. We will look at these variations on several time scales. For billions of years, the sun’s energy, the composition of the atmosphere, and the biosphere have experienced changes. During this time, Earth’s climate has varied from much hotter to much colder than today, but the variations were relatively small when compared to the climate on our neighbors Venus and Mars. Compared with them, Earth’s climate has been stable; the oceans neither evaporated nor froze solid. On shorter time scales, different processes are important. We will look at these past variations in Earth’s climate and oceans and try to understand the implications for possible climates of the future.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES260, ENVS290
Prereq: E&ES101 OR E&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197]

E&ES568 Isotope Geochemistry
This course explains from first principles the main stable and radioactive isotopic techniques used in biogeochemistry, environmental geochemistry, and geology. The oxygen, hydrogen, carbon, nitrogen, and sulfur stable isotope systems and the Rb-Sr, Sm-Nd, U-Th-Pb, and K-Ar radioactive systems will be discussed in detail. This course will emphasize the application of isotopic techniques in hydrological, geochemical, and ecological studies.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES368
Prereq: None

E&ES570 Quantitative Methods for the Biological and Environmental Sciences
This course offers an applied approach to statistics used in the biological, environmental, and earth sciences. Statistics will be taught from a geometric perspective so that students can more easily understand the derivations of formulae. We will learn about deduction and hypothesis testing as well as the assumptions that methods make and how violations affect applied outcomes. Emphasis will be on analysis of data, and there will be many problem sets to solve to help students become fluent with the methods. The course will focus on data and methods for continuous variables. In addition to basic statistics, we will cover regression, ANOVA, and contingency tables.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL242, BIOL542, E&ES270, ENVS242
Prereq: None

E&ES575 Modeling the Earth and Environment
Models can provide insights into Earth systems that are difficult to obtain by direct experimentation or observation. This course will introduce students to the process of translating Earth systems into idealized mathematical models, specific methods for solving the resulting equations, and implementation of models in MATLAB. We will explore cases from a range of topics in the earth and environmental sciences to gain a better appreciation of the insights models can offer.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES375
Prereq: MATH118 OR MATH122

E&ES580 Introduction to GIS
Geographical information systems (GIS) are powerful tools for organizing, analyzing, and displaying spatial data. GIS has applications in a wide variety of fields including the natural sciences, public policy, business, and the humanities—literally any field that uses spatially distributed information. In this course we will explore the fundamentals of GIS with an emphasis on practical application of GIS to problems from a range of disciplines. The course will cover the basic theory of GIS, data collection and input, data management, spatial analysis, visualization, and map preparation. Coursework will include lecture, discussion, and hands-on activities.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES280
Prereq: None

E&ES581 GIS Service-Learning Laboratory
This course supplements E&ES280 by providing students the opportunity to apply GIS concepts and skills to solve local problems in environmental sciences. Small groups of students will work closely with community groups to design a GIS, collect and analyze data, and draft a professional-quality report to the community.
Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-EES
Identical With: E&ES281
Prereq: None

E&ES582 Advanced GIS and Spatial Analyses
A geographic information system (GIS) is a powerful database that allows for the collection, manipulation, analysis, and presentation of spatially referenced data. GIS technologies facilitate science, social science, and humanities research that uses location-based data. This course will focus on individual projects conducted within a collaborative learning framework. Each student is responsible for developing and producing a semester-long project focused on advanced spatial
data analyses and/or advanced cartographic design using a GIS. Students will enter the course with an individual or small team (2-3 students) project in mind, such as a component of a senior thesis, work on a faculty member’s research project, or a community-based service-learning project. Course sessions will be a mix of studio time for projects (e.g., work time, critiques), skill development (e.g., lectures, student-led skills-training sessions), and intellectual advancement (e.g., guest speakers, conference attendance).

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES380, QAC344
Prereq: QAC231 OR E&ES280

E&ES585 Remote Sensing
This course studies the acquisition, processing, and interpretation of remotely sensed images and their application to geologic and environmental problems. Emphasis is on understanding the composition and evolution of the Earth and planetary surfaces using a variety of remote-sensing techniques. This course will discuss the theory and technology behind a number of remote sensing platforms and how data at different wavelengths interacts with rocks, soils, water and vegetation. It’s powerful stuff.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES385