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

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Robert Schumann Professor of Environmental Studies; Professor of Biology; Professor of Earth and Environmental Sciences; Chair, Environmental Studies Program; Director, College of the Environment; Professor, Environmental Studies

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Harold T. Stearns Professor of Earth Science; Professor of Earth and Environmental Sciences; Chair, Earth and Environmental Sciences; Professor, Integrative Sciences

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AFFILIATED FACULTY

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Distinguished Professor of the College of the Environment and Environmental Studies; Associate Professor, Earth and Environmental Sciences

VISITING FACULTY

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Daniel Mark Griffith
PHD, Wake Forest University
Visiting Assistant Professor, Quantitative Analysis Center; Visiting Assistant Professor of Earth and Environmental Science

Gebremedhin Gebremeskel Haile
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Smith Curator of Mineralogy and Petrology of the Joe Webb Peoples Museum of Natural History; Harold T. Stearns Professor of Earth Science, Emeritus

UNDERGRADUATE PROGRAM DEPARTMENTAL ADVISING EXPERTS

All program faculty

- Undergraduate Earth and Environmental Sciences Major (https://catalog.wesleyan.edu/departments/ees/ugrd-ees/)

- Master of Arts in Environmental Sciences (https://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 they range 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: **Crosslisting**
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&ES142F Astrogeochemistry: The Search for Life in the Solar System and Beyond (FYS)
This course will examine the role that geochemistry plays in our search for life in the Solar System as well as exoplanetary systems. We will examine the habitability of different environments on different bodies (Venus, Mars, Europa, Enceladus), and compare them to the environments of the ancient and modern Earth. We will consider what would constitute geochemical evidence of life in

these different systems, and how this can aid us to interpret chemical signals from exoplanets. We will also critically evaluate past and recent claims of extraterrestrial life.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Prereq: **None**

E&ES151 The Planets
More than 100 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: **OPT**
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 whole. The course will focus on the four major earth systems: land, water, air, and life and how their interactions determine past, current and future global changes. Required laboratory sections will meet every other week and include a combination of lab and field exercises.
Offering: **Host**
Grading: **OPT**
Credits: **1.25**
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 curriculum 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 course explores the interdisciplinary field of environmental studies to better understand the characteristics of human interaction with and dependence on the environment, and the causes and consequences of environmental degradation at local and global scales. We will explore key processes, characteristics, and phenomena of the natural world, and relevant human system and social dynamics. We will apply this information to identifying important issues and trends of global climate change and sustainability. Projects facilitate synthesis and application, skill development, reflection, and independent exploration.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS197, BIOL197**
Prereq: **None**

E&ES199 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&ES201 Geology of Connecticut
The geology of Connecticut offers a unique opportunity to study the formation and deformation of rocks dating back more than a billion years. These rocks occur in belts that each record the arrival of exotic (plate tectonic) terranes that together built and rebuilt the Appalachian mountain belt. Few states in the nation possess a similar diversity of exposed rock and mineral occurrences. The course consists of weekly Friday afternoon field trips to key localities. Students will learn how to recognize and classify different rock types and distinguish their formational and deformational histories. Emphasis will be on learning (1) to recognize the clues to identifying the origin and evolution of the large variety of sedimentary, volcanic, metamorphic, and igneous rocks in Connecticut and (2) to use them to reconstruct their plate tectonic context. We will include visits to historic sites that influenced our socioeconomic development such as the brownstone quarries and "copper" mines in the Connecticut Valley, and the granite quarries in the southeastern part of the state. A one-day required Saturday field trip will be scheduled during the first class meeting. Student co-enrollment in EE&S 213 or 223 or 230 is encouraged.

Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Prereq: **E&ES101 OR E&ES115 OR E&ES213 OR E&ES223 OR E&ES230**

E&ES213 Mineralogy
Most rocks and sediments are made up of a variety of minerals. Identifying and understanding these minerals are initial steps toward an understanding of the genesis and chemistry of Earth materials. Crystallography is elegant in its own right. In this course, we will study the crystal structure and composition of minerals, how they grow, their physical properties, and the principal methods used to examine them, including polarized-light microscopy and x-ray diffraction.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Prereq: **None**

E&ES214 Laboratory Study of Minerals
This lab course presents practical aspects of the recognition and study of the common minerals in the lab and in the field. It includes morphologic crystallography and hand specimen identification, the use of the polarizing microscope, and x-ray powder diffractometry.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-EES**
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&ES115 OR E&ES155 OR E&ES197 OR E&ES199**

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&ES115 OR E&ES155 OR E&ES197 OR E&ES199**

E&ES223 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 process 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**
Identical With: **E&ES523**
Prereq: **E&ES101 OR E&ES199 OR E&ES115 OR [ENVS197 or BIOL197 or E&ES197]**

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&ES101 OR E&ES199 OR E&ES115 OR [ENVS197 or BIOL197 or E&ES197]**

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&ES115 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 the climate.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **BIOL233, ENVS233**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR E&ES199 OR [ENVS197 or BIOL197 or E&ES197]**

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: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-EES**
Identical With: **BIOL229**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR E&ES199 OR [ENVS197 or BIOL197 or E&ES197]**

E&ES236 Nuclear Power Plant Design and the Three Mile Island, Chernobyl and Fukushima Accidents
This course provides an introduction to radiation, nuclear physics, and nuclear power plant design. It will trace the steps that led to the three most well-known nuclear power plant accidents: Three Mile Island, Chernobyl, and Fukushima. It provides information useful for evaluating the impact of nuclear power on environmental decision-making.

Starting with a history of the atomic discoveries and fundamental physics that led to the atomic bomb production at the end of WWII, the course will then trace the design steps that allowed commercial nuclear power plants to evolve from those weapon-making discoveries. Finally it will trace the accidents and the aftermath from the Three Mile Island, Chernobyl, and Fukushima nuclear power accidents.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS236**
Prereq: **None**

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: **1.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL346, BIOL546, E&ES538, ENVS340**
Prereq: **[BIOL182 or MB&B182] OR [ENVS197 or BIOL197 or E&ES197] 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: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR E&ES197 OR E&ES199 OR BIOL182**

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: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-EES**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR E&ES197 OR E&ES199 OR BIOL182**

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 ground-water 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-EES**
Identical With: **E&ES546**
Prereq: **E&ES101 OR E&ES115 OR E&ES197 OR BIOL197 OR ENVS197 OR E&ES199**

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-EES**
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-EES**
Identical With: **ENVS280**
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&ES253 Energy Sustainability: An examination of US, New England and Connecticut Energy
This course will survey the state of energy generation and use in Connecticut, New England, and the U.S. It will include fundamental characteristics of fossil, nuclear, and renewable energy, plus their impact on the local and national energy grid. It will examine how utilities maintain power, including the variable nature of many renewable sources. The course will also examine fuel reliability and impact on local and global air pollution. The course will examine pathways forward for the local and national energy grid. One to two site visits may be incorporated as part of the class, with potential sites including: ISO New England (Holyoke, Mass.), Trash-to-Energy (Hartford, Conn.), combined cycle plant, Kleen Energy plant (Middletown, Conn.), and Combined Heat & Power (UConn Cogen).
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS253**
Prereq: **None**

E&ES254 Renewable Energy
This course is an introduction to renewable energy from an Earth science perspective, covering the physical principles of power generation from natural energy flows and the transformation, transmission, and storage of energy on the electrical grid, as well as topics from energy markets and utilization. We focus on hydroelectric, wind, solar, geothermal, wave, and tidal energy, along with modern bioenergy. For comparison, we also briefly cover the conventional energy technology of fossil fuels and nuclear power. We discuss each renewable-energy resource, including the advantages, disadvantages, and environmental impacts of its accompanying technology. The course is quantitative with bi-weekly problem sets. Students are expected to gain theoretical and practical knowledge of renewable energy.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS239**
Prereq: **None**

E&ES255 The Changing Ocean
The Earth is always changing, and we're currently experiencing some of the most rapid changes to have occurred within the history of life. This course presents a topical approach to major oceanographic concepts, particularly those impacted by an anthropogenic change, by linking core concepts in modern oceanography with paleoceanographic proxies and the fossil record. We will integrate geological, chemical, physical, and biological oceanography across multiple timescales to build a conceptual understanding of not only how the ocean works but how we can understand the past, present, and future of the world's ocean.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
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 and cataloging of plant and animal specimens to add to the Wesleyan Environmental Archaeology Laboratory comparative collections. Students must be available for one weekend class meeting to complete 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&ES258 Community Paleoecology
The study of community paleoecology seeks to derive ecological meaning from the reconstruction of ancient ecosystems. From this vantage point, fossil assemblages are used to observe long-term patterns in biogeography, evolution, and organism-environment interactions. The overarching themes in this course will emphasize theoretical frameworks in community ecology and stratigraphic paleobiology that advance the collective understanding of how to read and interpret the fossil record to document ecosystem interactions over geologic history. Case studies from across Earth's history will underscore the necessity of examining past ecosystems to contextualize modern and future ecosystem structure. We will accomplish these aims with lectures, student presentations, readings of the primary literature, and the required accompanying lab course (E&ES259). Pre/co-requisites: BIOL182, E&ES101, E&ES115, E&ES155, E&ES197, or E&ES199.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR ENVS197 OR E&ES199 OR BIOL182**

E&ES259 Introductory Ecological Methods in R
This lab class is required of students enrolled in the accompanying lecture (EES 258). We will learn to use R to analyze paleontological records with multivariate methods and specifically become familiar with the vegan package for interpreting large ecological datasets such as species abundance data. Prior knowledge of or experience with R is not a prerequisite and beginners are especially encouraged to enroll in this course. Students with intermediate and advanced R skills are still welcome to enroll, but should recognize that much of this course will focus on the beginner experience. Assignments and projects will be collaborative, such that students across experience levels will work together to complete the course material. Pre/co-requisites: BIOL181/BIOL182, E&ES101, E&ES115, E&ES155, E&ES197, or E&ES199.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **E&ES101 OR E&ES115 OR EES155OR ENVS197 OR E&ES199 OR BIOL182**

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&ES199 OR E&ES115 OR [ENVS197 or BIOL197 or E&ES197]**

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**
Identical With: **ENVS292**
Prereq: **E&ES101 OR E&ES115 OR [E&ES197 or BIOL197 or ENVS197] OR E&ES199**

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&ES271Z Mapping the Pandemic
The COVID-19 pandemic has altered the global community's daily relationship with space and movement, both at a hyperlocal scale of social distancing to a global scale of disease spread. Spatiotemporal visualizations in the form of maps and apps have allowed us to watch the worldwide spread of COVID-19 and keep tabs on local case counts in our own spaces. Geographic information systems (GIS) provide citizens, researchers, health care providers, and policy makers with a powerful analytical framework for visualization, data exploration, spatial pattern recognition, response planning, and decision making within our life in the time of COVID-19. This course is designed to develop spatial thinking and visualization skills relevant to COVID-19. Students will look at (and critically evaluate) existing maps and apps related to the current pandemic, create their own maps and apps, and critically evaluate their classmates' maps and apps. Class meetings will consist of case study lectures/discussions, instructor-led skill-building workshops, studio work sessions, and presentation/critique sessions. Spatial data collection, management, analysis, and visualization will occur within a cloud-based GIS (ArcGIS Online). Readings prior to the first class will establish a baseline for student comprehension of the breadth of applied geospatial thinking in today's research arena. The course is aimed at students with limited or no prior GIS experience.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **QAC232Z**
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 lectures, discussions, and hands-on activities.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES580, ENVS278**
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: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES581**
Prereq: **None**

E&ES287 Mountain Geography: Physical and Human Dimensions
While nearly everyone is familiar with the importance of oceans and rainforests, mountain environments receive relatively little attention. Yet mountains are home to approximately one-tenth of world's people, cover 1/5 of the Earth's surface, and occur in 75 percent of the world's countries. As much as 80 percent of world's freshwater originates in mountains, and all of the world's major rivers have their headwaters in the highlands. More than half of humanity relies on the fresh water that accumulates in mountains for drinking, domestic use, irrigation, hydropower, industry, and transportation. Mountains are dynamic yet fragile ecosystems, home to some of the most disadvantaged but highly motivated people in the world, and centers of armed conflict. They present additional challenges to sustainable development because of their lack of infrastructure, communications, and historically marginalized cultures. Additionally, they are often among the first landscapes to display a range of climate change impacts, such as the recession of glaciers, formation of large glacial lakes, and glacial lake outburst floods (GLOF). The course will provide students with a broad and integrated overview of the physical and human dimensions of the mountain world. Covered within this interdisciplinary course will be lectures, videos, readings, and individual projects covering: - The geological origins of mountains, how they're built-up and worn-down over time. - The importance of mountains for biodiversity and water cycles, globally and locally. - The cultural significance of mountains to people around the globe, and how that relationship has evolved over time. - How mountains are used, how they're protected, and how today they're experiencing rapid change in a warming climate. - The basics of integrated conservation and development programs in mountains, including their design, monitoring, and evaluation - Basic skills related to staying healthy in the high altitude environment (acclimatization, preventing acute mountain sickness, evacuation basics, clothing layering, staying found)
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS287**
Prereq: **BIOL182 OR ENVS197 OR E&ES199**

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 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 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: **NSM-BIOL**
Identical With: **ENVS306, BIOL306**
Prereq: **None**

E&ES312 Global Change Biogeography
On our home planet, Earth, the current geologic epoch is characterized by rapid changes to the environment due to human behavior. Biogeography examines the spatiotemporal distribution of life on Earth, from species to ecosystems and from landscapes to continents. How is anthropogenic climate change modifying the distribution and function of organisms and ecosystems? What can we learn from

the evolutionary history of the life-planet system that can help us understand the possible impacts of future climates on the biosphere? To address these questions rigorously, we will explore primary literature from a wide range of theoretical and empirical studies. The course emphasizes inquiry, contact with primary literature, discussion, statistical and spatial coding, learning to obtain data, and visualization. The beginning of the semester provides an overview of physical geography and the Earth System, with field and data experiences that build remote sensing and spatial analysis skills. The second half of the semester is focused on the exploration of relevant scientific literature based on student interests and recent papers, as well as independent research projects.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **BIOL312, ENVS311**
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&ES513**
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&ES517**
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: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES519**
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&ES520**
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&ES521**
Prereq: **E&ES213 OR E&ES220 OR [E&ES223 or E&ES523] 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**
Prereq: **E&ES201 OR E&ES213 OR E&ES215 OR E&ES220 OR E&ES223 OR E&ES230**

E&ES327 The Microbial Fossil Record
This course invites students to investigate the fossil record of microbial life to reveal the outsized impact microbes have on Earth and environmental systems. We will explore topics such as the origin of life, micropaleontology, marine biogeochemistry, biological oceanography, environmental microbiology, and astrobiology. This course will present students with the opportunity to engage with primary literature, write integrative narratives, and craft microbially inspired creative works.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS327, E&ES527**
Prereq: **None**

E&ES329 Fire Ecology and Management
Fire is a fundamental ecological disturbance process that regulates the structure and function of plant communities worldwide. However, increasing aridity under climate change and shifting human land use in recent centuries have altered fire behavior, imperiling many species. This course explores the ecological and social aspects of fire and sustainable fire management on planet Earth. Students examine shifting fire regimes over time, from indigenous use of fire prior to European colonization of the globe, to contemporary fire management. Class participants study the effects of global climate change on fire regimes and how such changes influence contemporary fire regimes and human livelihoods. The course format consists of a mixture of lectures, field exercises, active class discussions, student presentations, and research papers.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-ENVS**
Identical With: **ENVS329, E&ES349**
Prereq: **BIOL182 or ENVS197 or BIOL216 or E&ES199**

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 nonhierarchical 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: **1.00**
Gen Ed Area: **NSM-ENVS**
Identical With: **ENVS369, BIOL368**
Prereq: **[E&ES197 or BIOL197] OR [BIOL182 or MB&B182]**

E&ES349 Fire Ecology and Management
Fire is a fundamental ecological disturbance process that regulates the structure and function of plant communities worldwide. However, increasing aridity under climate change and shifting human land use in recent centuries have altered fire behavior, imperiling many species. This course explores the ecological and social aspects of fire and sustainable fire management on planet Earth. Students examine shifting fire regimes over time, from indigenous use of fire prior to European colonization of the globe, to contemporary fire management. Class participants study the effects of global climate change on fire regimes and how such changes influence contemporary fire regimes and human livelihoods. The course format consists of a mixture of lectures, field exercises, active class discussions, student presentations, and research papers.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-ENVS**
Identical With: **ENVS329, E&ES329**
Prereq: **BIOL182 or ENVS197 or BIOL216 or E&ES199**

E&ES350 Animals in Archaeology
This laboratory course will explore how zooarchaeological methods for analyzing animal bones and teeth excavated from archaeological sites allow us to reconstruct ancient human-animal-environmental interactions. We will cover a range of topics and techniques, including hands-on sessions for the identification and quantification of faunal remains. By the end of the course, students will be able to identify every bone in the mammalian skeleton and distinguish between the bones of common non-mammalian taxa. Additional topics will include ancient DNA in zooarchaeology, bone stable isotope analyses, human-caused extinctions, animal domestication, bone artifact production, and animal sacrifice.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-ARCP, SBS-ARCP**
Identical With: **ARCP350, ENVS348**
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: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-ENVS**
Identical With: **ENVS361**
Prereq: **None**

E&ES368 Isotope Geochemistry
This class introduces the theory and application of the main radiogenic (Rb-Sr, Sm-Nd, U-Th-Pb, and K-Ar) and stable (O, H, C, N, S) isotopic techniques used in environmental geochemistry and geology. Applications include geochronology, earth evolution, provenance, biogeochemical cycles, paleoenvironments, paleoclimate, hydrology, paleontology, ecology, and archaeology.
Offering: **Host**
Grading: **OPT**
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. Students should have MATLAB installed on a laptop computer for in-class work. Spring 2021: Class will follow a hybrid mode with in-person meetings for discussions and student presentations and remote meetings for programming/ problem solving sessions. Fully remote students will be accepted.

Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES575**
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 diversification. Lectures will be combined with studying fossils. In the second part of the course, possible causes for mass extinction will be considered, together with their specific effects on environments and biota, and these predicted effects will be compared to what has been observed. Potential causes include asteroid and comet impacts, large volcanic eruptions, "hypercanes," and "methane ocean eruptions," and more exotic processes. Students will present in class on these topics, and we will compare rates and magnitude of environmental change with severity and patterns of extinction.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **CIS375**
Prereq: **E&ES101 OR E&ES115 OR ASTR155 OR MB&B181**

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.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES585**
Prereq: **[E&ES234 or BIOL233 or ENVS233] OR E&ES213 OR E&ES220 OR [E&ES223 or E&ES523] OR [E&ES250 or ENVS280] OR [E&ES260 or ENVS290 or E&ES560] OR E&ES215**

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&ES523] OR [E&ES234 or BIOL233 or ENVS233] OR [E&ES250 or ENVS280] OR [E&ES260 or ENVS290 or E&ES560]**

E&ES395 Quantitative Chemical Analysis
Measurement and chemical analysis are at the very heart of the chemical sciences. Practicing chemists depend heavily on chemical analysis, as do medical professionals, environmental scientists, and many others. Quantitative chemical analysis is the science of determining "how much"--as in, "how much toxic lead is in your drinking water?" In this course, you will first learn how to treat measured chemical data to extract meaningful information, and then we will proceed to study classical methods of chemical analysis, expanding upon your knowledge of general chemistry. A practical laboratory experience will reinforce the curriculum and build your skills as a chemist. This course is part of the required curriculum listed in the American Chemical Society Guidelines for Bachelor's Degree Programs, and this course is highly recommended for students who intend to pursue graduate studies and/or employment in a chemical discipline.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM317**
Prereq: **(CHEM142 OR CHEM142Z OR CHEM144) AND (CHEM152 OR CHEM152Z)**

E&ES396 Instrumental Analysis
Chemical analysis has kept pace with the advent of modern technology through the development of instruments capable of ever-improving levels of detection for both qualitative and quantitative analysis. Many students are exposed to the use and interpretation of these modern methods of chemical analysis, but this experience typically comes with little understanding of how and why these instruments work. This course will investigate instrumentation across three broad categories of analysis: electrochemical, spectrochemical, and separations. The lecture course will be supplemented with a practical laboratory experience. Instrumental analysis is part of the required curriculum listed in the American Chemical Society Guidelines for Bachelor's Degree Programs, and this course is highly recommended for students who intend to pursue graduate studies and/or employment in a chemical discipline.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM318**
Prereq: **(CHEM142 OR CHEM142Z OR CHEM144) AND (CHEM152 OR CHEM152Z)**

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.
Offering: **Host**
Grading: **Cr/U**

E&ES421 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: **Host**
Grading: **OPT**

E&ES422 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: **Host**
Grading: **OPT**

E&ES423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

E&ES424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

E&ES465 Education in the Field, Undergraduate
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.
Offering: **Host**
Grading: **A-F**

E&ES466 Education in the Field, Undergraduate
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.
Offering: **Host**
Grading: **OPT**

E&ES469 Education in the Field, Undergraduate
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **None**

E&ES491 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: **Host**
Grading: **OPT**

E&ES492 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: **Host**
Grading: **OPT**

E&ES497 Senior Seminar
This seminar-style capstone course for E&ES seniors focuses on career-building and improving scientific research skills by completing an original research project. In groups, students will develop original, field-based research projects, write a proposal, and complete the project. The goal of the course is to help students transition to independent, professional scientists.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Prereq: **None**

E&ES497A Introduction to Portuguese and the Azores
This course will be an introduction to Portuguese/Azorean history and geography. It will include an introduction to Portuguese pronunciation, greetings, basic expressions, food, weather, and vocabulary related to the geology and culture of the islands.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-EES**
Identical With: **CGST497A**
Prereq: **E&ES497**

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. 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: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **None**
Identical With: **ASTR500, CHEM500, BIOL500, 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**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES313**
Prereq: **E&ES213 OR E&ES215**

E&ES517 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: **Crosslisting**
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&ES518 E&ES Colloquium I
This course includes presentations by outside experts and discussion of material at the forefront of the discipline. The course is open to graduate students and undergraduate majors and potential majors. Attendance at all meetings required. Undergraduates may take this course up to four times for credit towards graduation.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

E&ES519 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&ES521 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: **Crosslisting**
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&ES523] OR [E&ES250 or ENVS280]**

E&ES523 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 process 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: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES223**
Prereq: **E&ES101 OR E&ES199 OR E&ES115 OR [ENVS197 or BIOL197 or E&ES197]**

E&ES527 The Microbial Fossil Record
This course invites students to investigate the fossil record of microbial life to reveal the outsized impact microbes have on Earth and environmental systems. We will explore topics such as the origin of life, micropaleontology, marine biogeochemistry, biological oceanography, environmental microbiology, and astrobiology. This course will present students with the opportunity to engage with primary literature, write integrative narratives, and craft microbially inspired creative works.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES327, ENVS327**
Prereq: **None**

E&ES528 E&ES Colloquium II
This course includes presentations by outside experts and discussion of material at the forefront of the discipline. The course is open to graduate students and undergraduate majors and potential majors. Attendance at all meetings required. Undergraduates may take this course up to four times for credit towards graduation.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

E&ES533 Planetary Science Journal Club
Presentation and discussion of current research articles in the field of planetary science.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-EES**
Prereq: **None**

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: **1.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL346, BIOL546, E&ES238, ENVS340**
Prereq: **[BIOL182 or MB&B182] OR [ENVS197 or BIOL197 or E&ES197] OR E&ES199**

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 ground-water 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-EES**
Identical With: **E&ES246**
Prereq: **E&ES101 OR E&ES115 OR E&ES197 OR BIOL197 OR ENVS197 OR E&ES199**

E&ES547 Environmental Biology Journal Club
Presentation and discussion of current research articles in the field of environmental biology.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **0.25**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL547**
Prereq: **BIOL182 OR E&ES197**

E&ES548 Environmental Biology Journal Club II
Presentation and discussion of current research articles in the field of environmental biology.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL548**
Prereq: **BIOL182 OR E&ES197**

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 who intend to pursue the planetary science concentration. Other graduate and undergraduate students may request admission to the course.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-EES**
Identical With: **ASTR555**
Prereq: **None**

E&ES557 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: **None**
Prereq: **None**

E&ES558 Research in Progress in Earth & Environmental Sciences
This course focuses on the discussion of research projects, strategies and challenges between the department faculty, postdocs, graduate and undergraduate students. The course offers a forum for presenting new results and exploring new directions, as well as for providing researchers with collaborative feedback and suggestions for solving methodological and analytical problems. It also provides an opportunity for 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**
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 [ENVS197 or BIOL197 or E&ES197]**

E&ES568 Isotope Geochemistry
This class introduces the theory and application of the main radiogenic (Rb-Sr, Sm-Nd, U-Th-Pb, and K-Ar) and stable (O, H, C, N, S) isotopic techniques used in environmental geochemistry and geology. Applications include geochronology, earth evolution, provenance, biogeochemical cycles, paleoenvironments, paleoclimate, hydrology, paleontology, ecology, and archaeology.
Offering: **Crosslisting**
Grading: **OPT**
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. Students should have MATLAB installed on a laptop computer for in-class work. Spring 2021: Class will follow a hybrid mode with in-person meetings for discussions and student presentations and remote meetings for programming/ problem solving sessions. Fully remote students will be accepted.
Offering: **Crosslisting**
Grading: **OPT**
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 lectures, discussions, and hands-on activities.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES280, ENVS278**
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: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES281**

Prereq: **None**

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.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES385**
Prereq: **[E&ES234 or BIOL233 or ENVS233] OR E&ES213 OR E&ES220 OR [E&ES223 or E&ES523] OR [E&ES250 or ENVS280] OR [E&ES260 or ENVS290 or E&ES560] OR E&ES215**