

EARTH AND ENVIRONMENTAL SCIENCES (E&ES)

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&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&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**

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 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, ENV5197**

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, 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&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENV5197]**

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 ENV5197]**

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**

Prereq: **E&ES101 OR E&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENV5197]**

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 [E&ES197 or BIOL197 or ENV5197]**

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 ENV5197] 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, ENV5233**

Prereq: **E&ES101 OR E&ES115 OR E&ES199 OR [E&ES197 or BIOL197 or ENV5197]**

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**

Credits: **0.50**

Gen Ed Area: **NSM-EES**

Identical With: **BIOL229**

Prereq: **E&ES101 OR E&ES115 OR E&ES199 OR [E&ES197 or BIOL197 or ENV5197]**

E&ES236 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 those 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 E&ES199 OR ASTR155 OR MB&B181**

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, ENV5340**

Prereq: **[BIOL182 or MB&B182] OR [E&ES197 or BIOL197 or ENV5197] 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-EES**

Prereq: **E&ES101 OR [E&ES197 or BIOL197 or ENVS197] OR E&ES199 OR [BIOL182 or MB&B182]**

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-EES**

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 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&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-EES**

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-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 ambient air is studied. General topics include equilibrium thermodynamics, acid-base equilibria, oxidation-reduction reactions, and isotope geochemistry. This course (together with the associated lab course, E&ES 251) 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.

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, dammed rivers, and polluted lakes.

Offering: **Host**

Grading: **A-F**

Credits: **0.50**

Gen Ed Area: **NSM-EES**

Identical With: **ENVS281**

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&ES199 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**

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, ENVS320**

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&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**

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&ES250 or ENV5280]**

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: **1.25**

Gen Ed Area: **NSM-ENVS**

Identical With: **ENVS369**

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)? To be effective in this course, students will need basic college-level proficiency in chemistry and math as we will delve into aspects of geochemistry, geology, toxicology, environmental law, and some math. The class consists of lectures, one major problem set, the Hg-in-hair class study, and a class project on pollution records from a 125-year-old tree slab that has year rings. We will drill all rings and analyze the wood for Hg, Pb, nuclear contaminants, and several stable isotopes. Some will do a paleoclimate record on the rings as well. Students will jointly write various sections of a report on this original research. This is also a service learning course, providing environmental outreach to the larger Middletown community on local pollution over the last 125 years (the tree slab with its records will go on display at Wesleyan).

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-ENVS**

Identical With: **ENVS361**

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&ES575**

Prereq: **MATH118 OR MATH122**

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 natural science, social science, and humanities research and any other project 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. The project may be a component of a senior thesis, work on a faculty member's research project, a community-based service-learning project, and so on. 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). Specific skills-training sessions will be determined by components of each project.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-EES**

Identical With: **QAC344, E&ES590**

Prereq: **QAC231 OR EES322**

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: **E&ES585**

Prereq: **[E&ES234 or BIOL233 or ENV5233] OR E&ES213 OR E&ES220 OR E&ES223 OR [E&ES250 or ENV5280] OR [E&ES260 or ENV5290 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&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 does not count towards the E&ES major and 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 explores major topics that span multiple sub-disciplines of the Earth and Environmental Sciences. Students will use the primary literature to create hypothesis-driven oral presentations and written reports. In groups, students will develop and execute original, field-based research projects. Data will be collected for these projects during a multi-day field trip. Students will then analyze and interpret their data, and then present their findings with a group presentation and written report. 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**

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**

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&ES250 or ENV5280]**

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, ENV5340**

Prereq: **[BIOL182 or MB&B182] OR [E&ES197 or BIOL197 or ENV5197] 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 ENV5197 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.

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&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, ENV5290**

Prereq: **E&ES101 OR E&ES199 OR E&ES115 OR [E&ES197 or BIOL197 or ENV5197]**

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 isotope 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, ENV5320**

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&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**

Prereq: **[E&ES234 or BIOL233 or ENV5233] OR E&ES213 OR E&ES220 OR E&ES223 OR [E&ES250 or ENV5280] OR [E&ES260 or ENV5290 or E&ES560] OR E&ES215**

E&ES590 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 natural science, social science, and humanities research and any other project 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. The project may be a component of a senior thesis, work on a faculty member's research project, a community-based service-learning project, and so on. 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). Specific skills-training sessions will be determined by components of each project.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-EES**

Identical With: **E&ES380, QAC344**

Prereq: **QAC231 OR EES322**