Our Bachelor of Science in Marine Biology degree is designed to provide a strong foundation in marine biology and related disciplines. This major is strongly influenced by the Three Seas Marine Biology program that is largely based at Northeastern University's Marine Science Center (MSC) in Nahant, but many courses satisfying this major are also offered on the main campus in Boston. Students in this major study all aspects of marine systems from invertebrate zoology to oceanography. For those students seeking a broader foundation that is not solely focused on marine systems, we also offer a Bachelor of Science in Ecology and Evolutionary Biology (EEB). Students majoring in EEB develop a strong theoretical foundation in ecology and evolution while also building practical skills in data science, genomics, and other areas at the cutting edge of science. Our core curriculum for both marine biology and EEB satisfy the vast majority of requirements for prehealth fields, including veterinary sciences and medical fields.

We offer a number of combined majors in both the BA track and the BS track. Students are also able to create their own combined majors with approval from faculty committees in both departments.

Fieldwork is a critical component of training in our programs, and many of our courses use field sites throughout New England to explore environmental processes or problems in their more complex and natural state. In addition to sponsoring local trips, our students also participate in longer field excursions to places like Iceland, Antarctica, the Florida Keys, the Cascade Mountains of Washington, and many others. Students also have the option to complete undergraduate research experiences with a faculty member. Undergraduate research projects can involve fieldwork and/or lab work guided by faculty mentors, and many projects evolve into senior and honors theses.

Our graduates work across a wide range of disciplines. Student training in the foundations of each major, coupled with extensive training in data science and scientific communication, allows our students to succeed in a range of positions from hydrology to public policy to oceanography. We have graduates working as environmental lawyers; lobbyists; consultants; planners; data analysts; educators; soil, air, and water quality technicians; veterinarians; foresters; geneticists; bioinformaticians; research divers; aquaculturists; and many more fascinating fields.

**THREE SEAS PROGRAM**

Three Seas is an accelerated, research-focused, graduate-level program that allows advanced undergraduate and beginning graduate students in marine biology and related areas to spend a year of field study in three distinct marine environments. As a prime example of Northeastern University's innovative teaching initiative, Three Seas emphasizes experiential learning by providing students with hands-on research experience to develop the critical skills needed to succeed in a career in science.

The program begins with students spending a semester studying the classic rocky intertidal and salt marsh ecosystems at Northeastern University's Marine Science Center (MSC) in Nahant, 12 miles north of the main campus. The following semester, the program travels abroad to both the University of Washington's Friday Harbor Laboratories (FHL) and to the Smithsonian Tropical Research Institute (STRI).

FHL, located on San Juan Island, is 70 miles north of Seattle and part of an archipelago that lies between the mainland and Vancouver Island. In the cold and well-mixed waters of the Puget Sound, students study rocky
shores, mudflats, sand beaches, kelp forests, and a range of subtidal environments.

STRI is located in the town of Bocas del Toro, on Isla Colon, an island on the northern Caribbean side of Panama. Students study Panama’s tropical ecosystem on both the Caribbean and Pacific coasts, which includes fringing coral reefs, seagrass, and mangrove habitats.

For more information, visit the Three Seas Program website (https://www.northeastern.edu/threeseas/).

MARINE SCIENCE CENTER SUMMER INTERNSHIP PROGRAM
This program provides a monthly stipend during the summer to students while they participate in intensive research with faculty members based at the Marine Science Center (MSC). Although students conduct independent research at the MSC laboratory primarily in the summer, these experiences can also extend throughout the year.

ACADEMIC PROGRESSION STANDARDS
Same as college standards.

Programs
Core Majors
- Ecology and Evolutionary Biology (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/ecology-evolutionary-biology-bs/) (BS)
- Environmental Studies (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-studies-ba/) (BA)
- Environmental and Sustainability Sciences (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-bs/) (BS)
- Marine Biology (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/marine-biology-bs/) (BS)

Combined Majors
- Computer Science and Environmental and Sustainability Sciences (http://catalog.northeastern.edu/undergraduate/computer-information-science/computer-information-science-combined-majors/computer-science-environmental-sustainability-sciences-bs/) (BS)
- Data Science and Ecology and Evolutionary Biology (http://catalog.northeastern.edu/undergraduate/computer-information-science/computer-information-science-combined-majors/data-science-ecology-evolutionary-biology-bs/) (BS)
- Data Science and Environmental and Sustainability Sciences (http://catalog.northeastern.edu/undergraduate/computer-information-science/computer-information-science-combined-majors/data-science-environmental-sustainability-sciences-bs/) (BS)
- Environmental and Sustainability Sciences and Chemistry (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-chemistry-bs/) (BS)
- Environmental and Sustainability Sciences and Economics (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-economics-bs/) (BS)
- Environmental and Sustainability Sciences and Landscape Architecture (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-landscape-architecture-bs/) (BS)

- Environmental Studies and History (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-studies-history-ba/) (BA)
- Environmental Studies and International Affairs (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-studies-international-affairs-ba/) (BA)
- Environmental Studies and Philosophy (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-studies-philosophy-ba/) (BA)
- Environmental Studies and Political Science (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-studies-political-science-ba/) (BA)
- Sociology and Environmental Studies (http://catalog.northeastern.edu/undergraduate/social-sciences-humanities/sociology-anthropology/sociology-environmental-studies-ba/) (BA)

Minors
- Ecology and Evolutionary Biology (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/ecology-evolutionary-biology-minor/)
- Environmental and Sustainability Sciences (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-minor/)
- Environmental Studies (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-studies-minor/)
- Geosciences (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/geosciences-minor/)
- Marine Sciences (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/marine-sciences-minor/)

Retired Programs
- Computer Science and Environmental Science, BS

Please see successor program: Computer Science and Environmental and Sustainability Sciences, BS (http://catalog.northeastern.edu/undergraduate/computer-information-science/computer-information-science-combined-majors/computer-science-environmental-sustainability-sciences-bs/)

- Data Science and Environmental Science, BS

Please see successor program: Data Science and Environmental and Sustainability Sciences, BS (http://catalog.northeastern.edu/undergraduate/computer-information-science/computer-information-science-combined-majors/data-science-environmental-sustainability-sciences-bs/)

- Environmental Science, BS

Please see successor program: Environmental and Sustainability Sciences, BS (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-bs/)

- Environmental Science and Chemistry, BS

Please see successor program: Environmental and Sustainability Sciences and Chemistry, BS (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-chemistry-bs/)
• Environmental Science and Landscape Architecture, BS

Please see successor program: Environmental and Sustainability Sciences and Landscape Architecture, BS (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-landscape-architecture-bs/)

• Environmental Studies and Economics, BS

Please see successor program: Environmental and Sustainability Sciences and Economics, BS (http://catalog.northeastern.edu/undergraduate/science/marine-environmental/environmental-sustainability-sciences-economics-bs/)

Courses

Ecology, Evolution, and Marine Biology Courses

Search EEMB Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=EEMB)

EEMB 1101. Foundations in Ecology and Evolutionary Biology. (4 Hours)

Introduces students to the foundational principles of ecology and evolutionary biology. Merges traditional lectures on foundational topics in ecology and evolutionary biology (adaptation, mechanisms of evolution, community and ecosystems ecology) with explorations of local field sites and an introduction to field ecology. Students spend several weeks of the semester designing and implementing independent field research projects, through which they are exposed to the foundation of scientific inquiry, including hypothesis testing, collecting, managing, and analyzing data, and presenting their findings.

Corequisite(s): EEMB 1102
Attribute(s): NUpath Natural/Designed World

EEMB 1102. Lab for EEMB 1101. (1 Hour)

Accompanies EEMB 1101. Covers topics from the course through various experiments.

Corequisite(s): EEMB 1101

EEMB 1105. Foundations in Ecological and Evolutionary Genomics. (4 Hours)

Introduces students to the foundational principles of molecular ecology with an emphasis on applications of high-throughput sequencing techniques to answer questions in ecology and evolutionary biology. Covers foundational topics in ecological and evolutionary genomics (central dogma, structure of nucleic acids, genetic variation, tools in molecular ecology, understanding genomes, and genomics). Practical skills development includes clean technique and proper bench skills; basic command line programming; understanding, quantifying, and analyzing sequence variation; and visualizing genomic data for formal scientific presentations.

Corequisite(s): EEMB 1106
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

EEMB 1106. Lab for EEMB 1105. (1 Hour)

Accompanies EEMB 1105. Covers topics from the course through various experiments. Focuses on providing firsthand experience using tools from molecular ecology to test ecological and/or evolutionary hypotheses.

Corequisite(s): EEMB 1105

EEMB 1145. Beginning Scuba. (1 Hour)

Focuses on basic skin diving and scuba diving skills, with emphasis on safety. Requires lab fee. Requires ability to pass a swim test and basic comfort in the water.

EEMB 1450. Introduction to Marine Biology. (4 Hours)

Surveys the tremendous diversity of marine organisms in the context of the major marine ecosystems in which they are found. Explores interactions among organisms and how the physical and chemical environment influence marine organisms. Links changes on land to declines in organism numbers and diversity and explores the benefits humans gain from our relationship with the marine environment. Offers opportunities to investigate recent advances and understanding of marine organisms and their environments.

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

EEMB 1990. Elective. (1-4 Hours)

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

EEMB 2290. Ecology and Evolution of Behavior. (4 Hours)

Studies fundamental biological principles at behavioral, ecological, and evolutionary levels. Covers ethology, ecology, genetics, and comparative psychology, all within the conceptual framework of evolutionary theory. Explores both scientific practice and progress through readings, discussion, and projects. Illustrates the process by which biologists study questions about the evolutionary origin of behavior through a series of in-class activities, computer modeling assignments, interpretation of graphical data, collection and statistical analyses of behavioral data, as well as the generation and presentation of research. Does not focus on the neurological basis of behavior. Offers students an opportunity to become critical thinkers, critical readers, and to attain tools to interpret the world in a unique way. Requires permission of advisor.

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

EEMB 2302. Ecology. (4 Hours)

Offers students an opportunity to learn about the environmental and biological processes that control the distribution and abundance of species and controlling factors that operate on individuals, populations, and communities. The lecture and laboratory introduce a set of generalizable concepts that are of fundamental importance to plant and animal life on the land and in the sea and provide hands-on experiential learning that reinforce concepts covered in lecture. Offers students an opportunity to become proficient in the following: (a) understanding research results the primary literature; (b) conducting a research experiment; (c) interpreting the results of in-class research; (d) communicating results as manuscript.

Prerequisite(s): ENGW 1111 with a minimum grade of C or ENGW 1102 with a minimum grade of C

Corequisite(s): EEMB 2303

Attribute(s): NUpath Formal/Quant Reasoning, NUpath Writing Intensive

EEMB 2303. Lab for EEMB 2302. (1 Hour)

Accompanies EEMB 2302. Covers topics from the course through various experiments.

Corequisite(s): EEMB 2302
**EEMB 2400. Introduction to Evolution. (4 Hours)**
Introduces evolutionary thinking, including contemporary examples of evolution. To understand the evolution of Charles Darwin's "endless forms most beautiful," the course adopts an integrative approach that includes information from ecology, genetics, molecular biology, biogeography, and paleobiology. Considers mechanisms of evolutionary change—how does it happen? Examines adaptation, the process by which attributes of an organism change to enhance fitness and the evolutionary history of life on our planet—what was the first living thing, how does speciation occur, what have we learned about evolution of life in the distant past, and how did humans evolve. Includes student presentations and analysis of scientific literature.

**Prerequisite(s):** BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or EEMB 1101 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-

**Attribute(s):** NUpath Natural/Designed World

**EEMB 2420. Fisheries Biology, Policy, and Conservation. (4 Hours)**
Focuses on the study and management of economically valuable fish species. Studies the basic biology and ecology of fisheries species, quantifying and modeling their population biology to their interactions with each other and the environment. Requires students to read and analyze the scientific literature, to complete worksheets and writing assignments, and to develop and present research projects. Covers traditional stock assessment methods as well as how fisheries science and management has evolved more recently to integrate community- and ecosystem-level information. Reviews fisheries and how fishers are managed, their involvement in the management process, and the future fisheries in the United States and elsewhere.

**Prerequisite(s):** ENGW 1111 with a minimum grade of C or ENGW 1102 with a minimum grade of C

**Attribute(s):** NUpath Analyzing/Using Data, NUpath Natural/Designed World, NUpath Writing Intensive

**EEMB 2700. Marine Biology. (4 Hours)**
Examines biological aspects of natural ocean ecosystems and the physical processes that regulate them. Covers distributions, abundances, and interactions of marine organisms; interactions between organisms and the transformation and flux of energy and matter in marine ecosystems; and aspects of physiology related to marine species distributions, abundances, and roles. Students generate, evaluate, discuss, and present data from primary research and apply their knowledge of the scientific method and biological concepts through the creation of a written grant proposal.

**Prerequisite(s):** (BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or EEMB 1101 with a minimum grade of D-); (ENGL 1101 with a minimum grade of C or ENGL 1102 with a minimum grade of C or ENGW 1111 with a minimum grade of C or ENGW 1102 with a minimum grade of C)

**Corequisite(s):** EEMB 2701

**Attribute(s):** NUpath Natural/Designed World, NUpath Writing Intensive

**EEMB 2701. Lab for EEMB 2700. (1 Hour)**
Accompanies EEMB 2700. Covers topics from the lecture course through discussions and experiments.

**Corequisite(s):** EEMB 2700

**EEMB 2990. Elective. (1-4 Hours)**
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

**EEMB 3001. Genetics and Evolution in Action. (4 Hours)**
Uses current topics in genetics and evolution to study how evolution shapes the world around us and impacts our society. Explores cutting-edge genetic approaches and concepts using case studies, media reports, and scientific papers. Covers emerging topics such as consumer genetic testing of human ancestry and genetic risk, tests and analyses of novel viruses such as Covid19, the evolution of antibiotic resistance, origins of immunity genetics of domestication, and human microbial interactions. Includes discussions and writing exercises designed to offer students an opportunity to develop critical scientific thinking and problem-solving skills.

**Prerequisite(s):** BIOL 2301 with a minimum grade of D-

**EEMB 3455. Ecosystems Ecology. (4 Hours)**
Focuses on the foundational principles of ecosystems ecology. Examines the flow of energy and materials through both the biosphere (plants, animals, and microbes) and the geosphere (soils, atmospheres, and oceans) and the role that humans are playing in altering these key fluxes. Studies elemental cycles that are critically important for human and environmental sustainability—including carbon, nitrogen, and phosphorus—and examines similarities and differences in these cycles and flows while drawing on examples from both terrestrial and marine systems. Seeks to understand how changes in ecosystem structure ultimately affect ecosystem function and how this translates into the important services ecosystems provide.

**Prerequisite(s):** BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or CHEM 1161 with a minimum grade of D- or CHEM 1214 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 2200 with a minimum grade of D-

**Attribute(s):** NUpath Analyzing/Using Data, NUpath Natural/Designed World

**EEMB 3455. Ecosystems Ecology. (4 Hours)**
Focuses on the foundational principles of ecosystems ecology. Examines the flow of energy and materials through both the biosphere (plants, animals, and microbes) and the geosphere (soils, atmospheres, and oceans) and the role that humans are playing in altering these key fluxes. Studies elemental cycles that are critically important for human and environmental sustainability—including carbon, nitrogen, and phosphorus—and examines similarities and differences in these cycles and flows while drawing on examples from both terrestrial and marine systems. Seeks to understand how changes in ecosystem structure ultimately affect ecosystem function and how this translates into the important services ecosystems provide.

**Prerequisite(s):** BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or CHEM 1161 with a minimum grade of D- or CHEM 1214 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 2200 with a minimum grade of D-

**Attribute(s):** NUpath Analyzing/Using Data, NUpath Natural/Designed World
EEMB 3460. Conservation Biology. (4 Hours)
Explores conservation biology, an interdisciplinary science that focuses on conservation of biological diversity at multiple levels. Emphasizes the causes and consequences of biodiversity loss and demonstrates how ecological and evolutionary principles are applied to conservation problems. Covers sustainability; climate change; introduced species; conservation of threatened and endangered species; and pollution, disease, and habitat restoration using examples from marine, aquatic, and terrestrial systems. Offers students an opportunity to read, discuss, evaluate, and present data from primary research through written assignments and oral debates and to apply this knowledge to conservation issues. Emphasizes critical thinking, problem solving, and recognizing multiple perspectives.

Prerequisite(s): BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or EEMB 1101 with a minimum grade of D- or EEMB 2302 with a minimum grade of C- or ENVR 1101 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-
Attribute(s): NUpath Writing Intensive

EEMB 3465. Ecological and Conservation Genomics. (4 Hours)
Offers an overview of ecological and conservation genetics, an interdisciplinary science that focuses on understanding the processes that determine genetic diversity at the individual to population level. Focuses on fundamental concepts in evolutionary ecology and population and quantitative genetics, then applies those concepts to solving real-world problems in conservation science. Covers harvested populations, inbreeding, climate change, introduced species, conservation of threatened and endangered species, adaptation, and habitat restoration. Exposes students to multiple sides of these issues and the science that underpins them. Offers students an opportunity to develop the R programming skills required to analyze the complex data sets that often emerge when addressing cutting-edge questions in genetics. Includes writing and coding exercises and mathematical derivations. Emphasizes critical thinking and problem solving.

Prerequisite(s): BIOL 2301 with a minimum grade of C- or CS 2500 with a minimum grade of C- or ECON 2350 with a minimum grade of D- or EEMB 2400 with a minimum grade of C- or ENVR 2500 with a minimum grade of C- or MATH 3081 with a minimum grade of C-
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

EEMB 3466. Disease Ecology. (4 Hours)
Covers the fundamentals of disease ecology and evolution. Focuses on how disease can impact the physiology of organisms and how this can, in turn, alter communities and ecosystems. Topics include mathematical theory on host-pathogen interactions; empirical studies of human, wildlife, insect, and plant host populations; emerging infectious diseases; effects on host behavior; host-parasite coevolution; multihost and multipathogen systems; and anthropogenic effects on disease. Includes writing exercises, with a special emphasis on critical thinking and problem solving.

Prerequisite(s): BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or EEMB 1101 with a minimum grade of D- or EEMB 2302 with a minimum grade of C- or ENVR 1101 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

EEMB 3470. Coastal Ecology and Sustainability. (4 Hours)
Designed to provide an integrated exposure to issues surrounding the ecology and sustainability of coastal and estuarine systems, with a particular focus on urban harbors. Exposes students to both the diversity and complexity of coastal habitats that exist both locally (salt marshes and seagrass beds) and globally (mangroves) and the mechanisms of estuarine and coastal functioning (geomorphology, biogeochemistry, microbial ecology, food webs, fisheries). Considers the ecosystem services provided by coastal systems and how those services are altered through human pressures.

Prerequisite(s): (CHEM 1211 with a minimum grade of D- or CHEM 1151 with a minimum grade of D-); (EEMB 1101 with a minimum grade of D- or BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or BIOL 1115 with a minimum grade of D-)

EEMB 3475. Wildlife Ecology. (4 Hours)
Focuses on wildlife ecology and management, with an emphasis on terrestrial species. Introduces habitat use, behavior, wildlife conservation, parasites and pathogens, wildlife sampling, wildlife management, food and nutrition, population viability, and conservation genetics. Offers students an opportunity to engage in analyzing primary literature, collection, interpretation, and wildlife data and using basic mathematical models.

Prerequisite(s): EEMB 2302 with a minimum grade of C
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

EEMB 3555. Networks and Natural Systems. (4 Hours)
Covers the properties of diverse biological networks and explores foundational computational methods for analyzing, visualizing, and performing statistical investigations of networked data. From social networks and cities to ecosystems and evolution, methods from network science provide powerful tools for understanding and investigating the natural and modern world. Moving beyond description, a key objective of the course is to synthesize the diversity of biological networks and investigate how scientists have uncovered remarkable regularities in networked systems by applying approaches from scaling theory to biological networks. Based on a series of case-studies, focuses on how to elucidate the structure and function of biological networks using empirical data. Requires scientific programming.

Prerequisite(s): ENVR 2500 with a minimum grade of D or DS 2000 with a minimum grade of D or ENVR 2500 with a minimum grade of D or MATH 2280 with a minimum grade of D or CHEM 1211 with a minimum grade of D or PHYS 1211 with a minimum grade of D or MATH 2280 with a minimum grade of D or PSYC 2320 with a minimum grade of D
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World
EEMB 3700. Desert Ecology. (4 Hours)
Offers students an opportunity to obtain a basic understanding of fundamental ecological processes taking place in desert environments. Familiarizes students with how environmental and biological processes interact and influence the distribution and abundance of species in these arid biomes while recognizing the impact that human societies have on desert life and identifying sustainable solutions to ameliorate our ecological footprint. Introduces students to foundational concepts of fundamental importance to desert plant and animal life. Uses an ecological perspective to surround students with a rich social/cultural milieu including interactions with Israeli, Palestinian, and Bedouin communities.

Prerequisite(s): EEMB 2302 with a minimum grade of D-; EEMB 2303 with a minimum grade of D-
Attribute(s): NUpath Difference/Diversity
EEMB 3990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

EEMB 4000. Applied Conservation Biology. (4 Hours)
Studies landscape-scale conservation in Transylvania and the Carpathian Mountains of Romania. Working intensively with Foundation Conservation Carpathia, explores efforts to build Europe's largest national park. Offers students an opportunity to learn from local conservation leaders, collect data, and develop plans to help launch the “Yellowstone of Europe.” Focuses on large carnivore conservation (brown bears, lynx, and wolves); sustainable agriculture; resource management in a country formerly under communist rule; and balancing urban and rural conservation needs. Explores Romania’s rich cultural heritage in Sighisoara, a UNESCO World Heritage Site, and Vacaresti Nature Park, a constructed urban wetland in the heart of Bucharest. Requires prior completion of one laboratory science course or permission of instructor.

Attribute(s): NUpath Integration Experience, NUpath Natural/Designed World
EEMB 4001. Landscape and Restoration Ecology. (4 Hours)
Topics include ecosystem processes, spatial patterns, disturbance, species distributions, invasive species, and habitat loss. Offers students an opportunity to participate in activities in which they look at and interpret spatial data. Course format includes group work, analyzing the scientific literature, and in-class activities.

Prerequisite(s): BIOL 1107 with a minimum grade of C or BIOL 1111 with a minimum grade of C or EEMB 1101 with a minimum grade of C or ENVR 1101 with a minimum grade of C or ENVR 1400 with a minimum grade of C.
Attribute(s): NUpath Natural/Designed World
EEMB 4010. Biology of Mammals. (4 Hours)
Surveys the mammals of the world, including their evolution, morphology, physiology, behavior, and ecology. Students conduct a research project in which they investigate the morphology, evolution, ecology, and behavior of a species and present their findings to the class. Includes reading and analyzing the scientific literature and conducting in-class activities.

Prerequisite(s): BIOL 1113 with a minimum grade of D- or BIOL 2299 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or EEMB 2400 with a minimum grade of D-
Attribute(s): NUpath Natural/Designed World
EEMB 4548. Sociobiology. (4 Hours)
Studies sociobiology, a field of biology that strives to understand the biological basis of social behavior in animals. Sociobiology is a multidisciplinary science, meshing together ethology (animal behavior), ecology, genetics, population biology, and comparative psychology, all within the conceptual framework of evolutionary theory. Why do animals live in societies? Why do animals cooperate and sometimes show extreme forms of altruism? What are the costs and benefits of group living? Reviews studies on nonhuman animals that demonstrate sociobiological principles by using a series of in-class activities, computer-modeling assignments, interpretation of graphical and tabulated data, collection and statistical analyses of behavioral data, as well as the generation and presentation of research.

Prerequisite(s): BIOL 2301 with a minimum grade of D-
Attribute(s): NUpath Analyzing/Using Data
EEMB 4990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

EEMB 4992. Directed Study. (1-4 Hours)
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

EEMB 5130. Ecological Dynamics. (4 Hours)
Offers a comprehensive overview of mathematical and computational concepts needed to construct (meta)population, (meta)community, and (meta)ecosystem models. Focuses on how to mathematically derive and model processes (growth, trophic and nontrrophic species interactions, dispersal, and environmental variability) to understand patterns of population abundance and species diversity. Emphasizes the mathematical tools required to analyze the dynamical behavior of ecological models (stability, invasion, graphical, and numerical analyses) and validate model predictions using empirical data (via maximum likelihood and optimization methods). Sophomores admitted by permission of instructor.

Prerequisite(s): (MATH 1241 (may be taken concurrently) with a minimum grade of D- or MATH 1251 (may be taken concurrently) with a minimum grade of D-) or (MATH 1341 (may be taken concurrently) with a minimum grade of D-); (ENGW 1111 with a minimum grade of C or ENGW 1102 with a minimum grade of C or ENGL 1111 with a minimum grade of C or ENGL 1102 with a minimum grade of C)) or graduate program admission
Corequisite(s): EEMB 5131
Attribute(s): NUpath Writing Intensive
EEMB 5131. Lab for EEMB 5130. (1 Hour)
Accompanies EEMB 5130. Offers supervised lab sessions designed to show how the topics covered in the lectures can be addressed in industry-standard programming environments.
Corequisite(s): EEMB 5130
EEMB 5303. Marine Biology Careers Seminar. (1 Hour)
Covers the information and tools needed to begin pursuing career opportunities in marine biology. Encourages students to explore a variety of career paths, construct résumés, contact potential employers for their internship and permanent positions. Presents invited speakers from state and federal agencies, and from private consulting firms, to talk about their work and career track.
EEMB 5305. Professional Development for Ocean Sciences. (2 Hours)
Designed to assist Three Seas students in securing a graduate research internship. Seeks to provide students with the information needed to pursue diverse career opportunities in marine biology. Provides hands-on experience with an array of science communication tools, including resumés/CVs, cover letters, and social media. Speakers from academia, informal science education organizations, and the media present talks on their work and career tracks.

EEMB 5504. Biology of Corals. (2 Hours)
Covers a variety of topics including basic coral biology, the coral-algal symbioses, the mechanisms of coral bleaching, coral microbiology and disease, coral calcification and ocean acidification, and coral speciation and hybridization. Supplements lectures with readings from the primary literature. Focuses on active areas of research and hands-on learning through lab and field activities.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission
Corequisite(s): EEMB 5505
Attribute(s): NUpath Analyzing/Using Data

EEMB 5505. Lab for EEMB 5504. (1 Hour)
Accompanies EEMB 5504. Focuses on relevant research questions while providing practical training techniques in coral biology. Hands-on learning includes visual surveys of reef transects, quadrat sampling, coral identification, enumeration of zooxanthellae with a hemocytometer, PAM fluorometry, ImageJ analysis, coral homogenization, and Vibrio plating.

Corequisite(s): EEMB 5504

EEMB 5506. Biology and Ecology of Fishes. (2 Hours)
Covers fundamental concepts in reef fish biology, ecology, and conservation. Additional lecture coursework includes analysis of both group and individual research projects conducted in lab. Presents recent or ongoing research projects by the instructor and guest lecturers. Discussions are based on papers from the scientific literature and relate topics about processes and patterns of fish recruitment, reproduction, dispersal, evolution, conservation, and management.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission
Corequisite(s): EEMB 5507

EEMB 5507. Lab for EEMB 5506. (1 Hour)
Accompanies EEMB 5506. Studies methods to conduct research on reef fishes through class exercises and individual research projects. Hands-on learning includes common fish transect methodology, reef fish identification, cast net and handline (on scuba) fishing techniques, and specimen dissection. Emphasizes analyzing and presenting the data and writing clearly and effectively about scientific research through the lab reports.

Corequisite(s): EEMB 5506

EEMB 5508. Marine Birds and Mammals. (3 Hours)
Studies principles of classification, anatomy, physiology, behavior, and evolution of seabirds and marine mammals. Also addresses conservation and protection of animals and essential habitat. Includes field trips to observe local species.

Prerequisite(s): (BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D-) or graduate program admission

EEMB 5510. New England Marine Biomes. (4 Hours)
Investigates the major biomes in the northwest Atlantic, including their habitats—rocky intertidal, tidal estuaries, seagrass beds, kelp forest/rocky reef complex, soft sediments, salt marshes, and continental shelf. Studies the major chemical, physical, geological, and biological forces that shape each habitat. Investigates the ecological framework of each habitat, both in the field and in hands-on exercises. Examines the adaptations of plants, algae, and animals to their respective ecosystem. Offers students an opportunity to develop an appreciation for human-induced changes in each habitat and biome and the conservation and restoration efforts currently being used.

Prerequisite(s): (EEMB 2302 with a minimum grade of D- or EEMB 2700 with a minimum grade of D- or EEMB 3460 with a minimum grade of D- or EEMB 3475 with a minimum grade of D- or EEMB 4001 with a minimum grade of D-) or graduate program admission

EEMB 5512. Tropical Terrestrial Ecology. (1 Hour)
Studies the animals, plants, and ecosystems of the new world tropics, with the community structure and diversity of terrestrial Jamaican habitats as an example. Includes field trips to lowland forests, carbonate caves, and the Blue Mountain mist-montane forest. The issue of land use and development vs. conservation is a recurring theme.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission

EEMB 5516. Oceanography. (4 Hours)
Offers an integrated overview of physical, chemical, biological, and geological processes operating in the world ocean. Seemingly unrelated topics like plate tectonics, oscillating currents and waves in the atmosphere, the activities of microbes and phytoplankton, and land-use practices in the middle of the continent have global reach and interact with each other in surprising yet understandable ways. Examines how new technologies have allowed stunning insights into global weather and climate, the deep sea, biodiversity, and how the biogeochemistry of the oceans can be measured and understood. Presents data use and analysis and formal reasoning used in marine science. Views the ocean as a “system of systems” where integration of experience from disparate disciplines is key.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission
Corequisite(s): EEMB 5517
Attribute(s): NUpath Analyzing/Using Data, NUpath Formal/Quant Reasoning

EEMB 5517. Lab for EEMB 5516. (1 Hour)
Accompanies EEMB 5516. Offers experiential field and laboratory exercises in oceanography. The New England rocky intertidal, subtidal, wetlands, barrier islands, and dunes provide opportunities for field exercises in marine geology, physical oceanography, and marine ecology. Investigates processes affecting changes in the global ocean, such as ocean acidification; temperature stress in organisms; hydrodynamic drag and lift; suspension feeding; and the ecophysiology of reef corals, boreal invertebrates, and macroalgae.

Corequisite(s): EEMB 5516
EEMB 5518. Ocean and Coastal Processes. (2 Hours)
Examines the coupling between physical and biological processes on coral reefs and adjacent habitats. Focuses on biophysical, oceanographic, and benthic-pelagic processes acting in coral reef and associated nearshore ecosystems. Specific topics include oceanographic forcing mechanisms, organismal biomechanics, hydrodynamics, and nutrient dynamics.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission
Corequisite(s): EEMB 5519

EEMB 5519. Lab for EEMB 5518. (1 Hour)
Accompanies EEMB 5518. Studies techniques such as estimation of turbulent diffusion coefficients, mean speed, and logarithmic layer parameters using analysis of video imagery (NIH ImageJ); deploying and recovering zooplankton traps and nets and estimating mortality using vital dyes; use of GoPro for behavioral analyses (sediment shedding in corals); estimating flux rates from active suspension feeders like sponges using dye release; and use of the YSI Exo Sonde to measure different water quality parameters.

Corequisite(s): EEMB 5518

EEMB 5520. Tropical Marine Ecology. (2 Hours)
Highlights and explores the ecological characteristics and current threats facing four tropical ecosystems—coral reefs, seagrass beds, mangrove forests, and tropical lowland rain forests. Explores the connectivity between these ecosystems and the services each provides. Examines how these ecosystems have changed under past threats and are projected to change in future conditions. Includes formal lectures, informal lectures provided in the field, field demonstrations, and interpretive hikes.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission

EEMB 5522. Experimental Design Marine Ecology. (4 Hours)
Includes introduction to and application of observational methods in three local marine habitats, experimental design, statistical analysis, R statistical computing and graphics software, and principles of marine ecology. Combines lecture, hand-on research experience, and computer laboratory and includes reading and analyzing the scientific literature and developing research projects. At the end of the semester, students are expected to demonstrate an integrative mastery of course topics by writing a scientific manuscript about a class experiment. Seeks to prepare students for practicing ecology in new environments and to provide students with the foundational knowledge necessary for pursuing more complex concepts in experimental design, statistical analysis, and marine ecology.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission
Attribute(s): NUpath Analyzing/Using Data, NUpath Writing Intensive

EEMB 5525. Advanced Field Methods in Marine Ecology. (3 Hours)
Explores the methods used to build and complete scientific studies in marine ecology from observation to data analysis and interpretation within the context of the northwest Atlantic Ocean. Offers students an opportunity to build quantitative skills by understanding how and when to apply different statistical methods to a range of ecological datasets. Studies how to appropriately interpret results and effectively communicate the interpretation to any audience. Applies these skills to additional study systems outside the marine environment of the northwest Atlantic.

Prerequisite(s): ENVR 2500 with a minimum grade of D- or graduate program admission

EEMB 5528. Marine Conservation Biology. (3 Hours)
Examines several critical issues facing marine ecosystems, including invasive species, marine pollution and eutrophication, fisheries impacts, physical alteration of habitats, and global climate change. Offers students an opportunity to spend field time surveying intertidal and subtidal habitats within the San Juan Islands and Friday Harbor Marine Reserve and to conduct independent research projects.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission

EEMB 5532. Physiological and Molecular Marine Ecology. (3 Hours)
Explores the physiological responses of marine organisms to variations in environmental factors. Uses complementary techniques, including molecular and physiological approaches, to determine genetic relationships at the species and population level and elucidate the mechanistic basis of organismic responses to environmental conditions at the level of genes and gene products.

Prerequisite(s): BIOL 2311 with a minimum grade of D- or EEMB 2302 with a minimum grade of D- or graduate program admission

EEMB 5533. Marine Invertebrate Zoology and Botany. (2 Hours)
Explores major groups of marine macroalgae and marine invertebrates, their ecological roles, and interrelationships. Identifies defining features of these groups and the evolutionary and ecological drivers leading to adaptations. Emphasizes important groups in the Pacific Northwest habitats, including kelp forest and rocky intertidal habitats. Hands-on learning with corequisite lab includes field identification; visits to intertidal and subtidal marine environments; and specimen observation, dissection, preparation, and cataloging.

Corequisite(s): EEMB 5535

EEMB 5535. Lab for EEMB 5533. (1 Hour)
Accompanies EEMB 5533. Covers topics from the course through various experiments.

Corequisite(s): EEMB 5533

EEMB 5538. Conservation and Restoration of Marine Systems. (3 Hours)
Designed to foster an understanding of conservation and restoration strategies in the nearshore marine system using a real-world case study approach. Students collect and analyze historical and newly collected data and use this to inform a conservation and restoration plan within the context of local, state, and federal laws. Uses real-world examples (such as aquaculture, seagrass restoration, and shoreline hardening) to build ecological goals. Seeks to build understanding and appreciation of the input of all stakeholders, including that of marginalized groups. Offers students an opportunity to produce a high-level and annotated deliverable that could serve as a template for real-world use.
EEMB 5540. Changing Global Oceans. (2 Hours)
Investigates the major drivers to short-, medium-, and long-term changes in the world's oceans. Compares the role of natural and human-induced changes in ocean systems. Key areas focus on the role of nonhuman animals in modifying and mitigating oceanic and atmospheric change. Explores the linkages among oceans and atmosphere through examples in the Pacific Northwest and worldwide.

Corequisite(s): EEMB 5541

EEMB 5541. Lab for EEMB 5540. (1 Hour)
Accompanies EEMB 5540. Students participate in daily, topical, paper discussions, carry out laboratory exercises, or explore and collect data in field exercises. Offers students an opportunity to acquire skills such as using oceanographic equipment, modeling simulations, data collection, and data analysis.

Corequisite(s): EEMB 5540

EEMB 5542. Marine Spatial Planning. (4 Hours)
Investigates issues of marine and coastal spatial planning (MCSP) that include offshore wind power siting, fisheries and aquaculture management, natural resource extraction, marine mammal conservation, and/or living shoreline protection and mitigation. Covers the spatial planning process from question to deliverable strategy, including assessment of stakeholder needs and potential ecosystem impacts. Offers students an opportunity to acquire and assess data, apply appropriate statistical tools, and develop spatial maps using geographic information systems (GIS) and other software. Also covers how to synthesize the planning process and develop and evaluate recommendations.

Prerequisite(s): EEMB 2302 with a minimum grade of D- or EEMB 2700 with a minimum grade of D- or EEMB 2700 with a minimum grade of D- or EEMB 3460 with a minimum grade of D- or EEMB 4001 with a minimum grade of D-

Attribute(s): NUpath Capstone Experience

EEMB 5546. Sustainability of the Land-Sea Interface. (3 Hours)
Explores the current issues facing management and conservation of the land-sea interface, also known as the coastal transition zone (CTZ). Evaluates the mitigation, conservation, and restoration tools that are applied to human use of the land-sea interface. Observes these tools during site visits and discusses strategies with experts in sustainability of these habitats. Synthesizes the scientific literature on CTZ tools in the northwest Atlantic and other regions with pressing sustainable land-sea use issues. Offers students an opportunity to develop skills in prioritizing and advocating for particular conservation strategies and to practice science communication skills to effectively reach a broad audience.

Prerequisite(s): (EEMB 2302 with a minimum grade of D- or EEMB 2700 with a minimum grade of D- or EEMB 3460 with a minimum grade of D- or EEMB 4001 with a minimum grade of D-) or graduate program admission

Attribute(s): NUpath Writing Intensive

EEMB 5589. Diving Research Methods. (2 Hours)
Provides an overview of what we know about the causes, locations, and effects of some of the most important natural disasters such as earthquakes, floods, and hurricanes. Also examines how loss of life and property damage can be minimized by implementing geologic knowledge. Briefly examines less common but possibly more devastating catastrophes such as large volcanic eruptions, large meteorite impacts, and rapid climate change.

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

ENVR 1000. Marine and Environmental Sciences at Northeastern. (1 Hour)
Intended for first-year students in the College of Science. Introduces students to liberal arts; familiarizes them with their major; develops the academic skills necessary to succeed (analytical ability and critical thinking); provides grounding in the culture and values of the University community; and helps to develop interpersonal skills—in short, familiarizes students with all skills needed to become a successful university student.

ENVR 1101. Environmental Science. (4 Hours)
Focuses on the complex array of topics that collectively form the discipline of environmental science. Emphasizes the problems facing today's natural, human-managed, and coupled human/natural ecosystems and the solutions to those problems. Studies the human dimensions of environmental science, including culture, politics, worldviews, ethics, and economics, particularly within the context of global climate change. Offers students an opportunity to learn to analyze data as a means of exploring relationships among societal and ecological drivers affecting economic, ecological, and socioeconomic stability; to learn how the scientific method is used to separate fact and data from opinion; and to apply these methods to explore the causes and solutions to global climate change.

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

ENVR 1103. Age of Dinosaurs. (4 Hours)
Utilizes evidence from the sedimentary rock record to evaluate and to interpret significant biological and physical events in Mesozoic earth history. Changes in the Earth's landscape due to variations in climate, plate tectonics, and sea level provide the background for detailed consideration of Mesozoic life. Emphasizes the evolutionary history of dinosaurs and provides detailed data for testing hypotheses of evolutionary mechanisms, paleobiogeography, functional anatomy, ecology and community structure, and extinction and extinction models.

Attribute(s): NUpath Natural/Designed World

ENVR 1104. Natural Disasters and Catastrophes. (4 Hours)
Provides an overview of what we know about the causes, locations, and effects of some of the most important natural disasters such as earthquakes, floods, and hurricanes. Also examines how loss of life and property damage can be minimized by implementing geologic knowledge. Briefly examines less common but possibly more devastating catastrophes such as large volcanic eruptions, large meteorite impacts, and rapid climate change.

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

ENVR 1110. Global Climate Change. (4 Hours)
Analyzes Earth's modern climate system and natural climate change over Earth's 4.5-billion-year history. Examines ongoing and future climate change. Includes expected impacts of the predicted climate changes as well as mitigation and adaptation options.

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World
ENVR 1120. Oceans and Coasts. (4 Hours)
Explores the marine and coastal realm and the problems that arise from the human-marine relationship. Begins by studying the history of the ocean and ends with how to create a more sustainable marine world. Topics covered include ocean and estuarine circulation, climate change and ocean response, and the plant and animal life thriving in different parts of the ocean. Includes reading and analyzing the scientific literature, developing and presenting research projects, and group work.

Attribute(s): NUpath Natural/Designed World

ENVR 1200. Dynamic Earth. (4 Hours)
Offers a systematic study of the materials and systems comprising the earth. Emphasizes the processes that form, transport, alter, and destroy rocks, as well as the nature and development of landscape. Plate tectonics theory is introduced as a guiding paradigm in geology.

Attribute(s): NUpath Natural/Designed World

ENVR 1201. Lab for ENVR 1200. (1 Hour)
Accompanies ENVR 1200. Covers exercises pertaining to mineral and rock identification and topographic and geologic map interpretation. Required for environmental geology and geology majors.

Prerequisite(s): ENVR 1200 (may be taken concurrently) with a minimum grade of D-

ENVR 1202. History of Earth and Life. (4 Hours)
Traces biological and environmental development of the earth over the past 4.6 billion years using evidence preserved in the rock record. A primary goal is to understand how geoscientists interpret earth history by learning how to test hypotheses and develop explanations for events that occurred far in the geologic past. Examination of major earth systems, the biosphere, lithosphere, atmosphere and hydrosphere, reveals how they interact to control the origin of the earth, the origin and evolution of life, the causes and effects of extinction, plate tectonics and mountain building, and climate change over earth history.

Attribute(s): NUpath Natural/Designed World

ENVR 1203. Interpreting Earth History. (1 Hour)
Focuses on students using sedimentary rocks, fossils, and geologic maps and stratigraphic sections to record and to interpret events in earth history.

Attribute(s): NUpath Natural/Designed World

ENVR 1400. Foundations in Environmental and Sustainability Sciences. (4 Hours)
Presents a series of lectures and case studies focused on the problems facing today's natural, human-managed, and coupled human/natural ecosystems. Integrates the underlying science with the human dimensions of environmental challenges. These include an understanding of the basic chemistry, physics, and ecology of environmental change and how this science is informed and altered by culture, politics, worldviews, ethics, and economics. Examines quantitative techniques to analyze data as a means of exploring relationships among societal and ecological drivers affecting economic, ecological, and socioeconomic stability. Studies how the scientific method is used to separate facts and data from opinion and applies these methods to explore the causes and solutions to global climate change and other environmental challenges.

Corequisite(s): ENVR 1401
Attribute(s): NUpath Natural/Designed World

ENVR 1401. Lab for ENVR 1400. (1 Hour)
Accompanies ENVR 1400. Offers supervised lab/discussion sessions for students to develop the tools needed to tackle environmental problem solving at the interface of human and natural systems.

Corequisite(s): ENVR 1400

ENVR 1500. Introduction to Environmental, Social, and Biological Data. (4 Hours)
Introduces the fundamental concepts in the fields of environmental, social, and biological science. Studies the expertise needed in each discipline to organize and manage data in sustainability science. The first half of the course covers data collection relevant to pressing issues in sustainability, database organization, coding, and finding errors in data sets. The second half of the course covers basic principles in the statistical analysis of data sets used in conservation and sustainability, including simulating data, machine learning, and errors in analysis. Offers hands-on experience through students' own data collection projects. Appropriate for students interested in biology, marine biology, environmental science, and ecology and evolutionary biology. Designed to prepare students for co-ops and upper-level classes in these fields.

Corequisite(s): ENVR 1501

ENVR 1501. Lab for ENVR 1500. (1 Hour)
Accompanies ENVR 1500. Offers supervised lab sessions demonstrating how topics covered in the lectures can be addressed using a variety of platforms, including Excel, R, and Python.

Corequisite(s): ENVR 1500

Attribute(s): NUpath Analyzing/Using Data

ENVR 1990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVR 2200. Earth's Changing Cycles. (4 Hours)
Introduces the biological, chemical, and physical interactions that shape our environment and how industrial emission of gases and black carbon, the use of fertilizers and plastics, and the expansion of cities are altering Earth's systems at rates unprecedented in the recent geological record. Offers students an opportunity to build a fundamental understanding of major issues in environmental science, including climate change, eutrophication, loss of biodiversity, and urbanization. Considers how we might build a more sustainable future.

Attribute(s): NUpath Natural/Designed World

ENVR 2310. Earth Materials. (4 Hours)
Describes the physical and chemical characteristics of common rock-forming minerals and geologic processes that form rock and soils in the igneous, sedimentary, and metamorphic environments. Focuses on commonly encountered minerals, soil, and rock types and how these are used to interpret past and present earth processes. This is a writing-intensive course with a required term paper.

Prerequisite(s): (ENVR 1101 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-); (ENGL 1111 with a minimum grade of C or ENGL 1102 with a minimum grade of C or ENGW 1111 with a minimum grade of C or ENGW 1102 with a minimum grade of C)
Attribute(s): NUpath Writing Intensive

ENVR 2311. Lab for ENVR 2310. (1 Hour)
Accompanies ENVR 2310. Cover topics from the course through various experiments.
ENVR 2330. Field Methods in Global Change. (4 Hours)
Endeavors to teach basic field methods in global change science through a suite of hands-on field projects based in the Emerald Necklace park system adjacent to Northeastern's Boston campus. Offers students an opportunity to learn basic skills in generating primary scientific data (i.e., abstracting data directly from nature), thereby functioning as a pillar for higher-level course work and research within the MES majors. Exposes students to fundamental content (e.g., fluvial geomorphology, biogeochemistry of natural waters, environmental pollution, sedimentology/stratigraphy) and skills (e.g., hypothesis generation and testing, topographic survey, map making, sedimentary coring, sampling and analysis of natural waters, producing scientific illustrations/graphs/videos, scientific writing) in global change science.

Prerequisite(s): ENVR 1101 with a minimum grade of D- or ENVR 1110 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 1202 with a minimum grade of D-
Attribute(s): NUpath Integration Experience, NUpath Natural/Designed World

ENVR 2340. Earth Landforms and Processes. (4 Hours)
Focuses on the origin and evolution of landscape features by processes operating at or near the earth's surface. Exercises introduce interpretation of air photos, topographic maps, remotely sensed data, and digital elevation models.

Prerequisite(s): ENVR 1200 with a minimum grade of D-
Corequisite(s): ENVR 2341

ENVR 2341. Lab for ENVR 2340. (1 Hour)
Accompanies ENVR 2340. Covers topics from the course through various experiments.

Corequisite(s): ENVR 2340

ENVR 2401. Food Justice and Community Development. (4 Hours)
Uncovers and examines the key dilemmas of the food system in the United States today using readings, media, discussion, service-learning, and field trips. Working from the foundations of environmental justice and community development, covers production, access, distribution, and key stakeholders from producers to retailers, workers, and consumers. Considers what justice-related issues face stakeholders within the food system in the United States; what policies have most impacted the workforce in the American food system; and what the opportunities and leverage points are for change in improving justice outcomes in this system.

Attribute(s): NUpath Integration Experience

ENVR 2420. Fisheries Biology, Policy, and Conservation. (4 Hours)
Considers how we study and manage economically valuable fish species. Reviews how we study the basic biology and ecology of fisheries species, ranging from their population biology to their interactions with each other and the environment (i.e., their role in community ecology and ecosystem function). Covers traditional stock assessment models and more recent fisheries models that integrate community- and ecosystem-level information. Reviews how human activities have affected their biology and economics and past and ongoing efforts to manage and conserve fisheries, ranging from traditional single-species approaches to more recent fisheries approaches to ecosystem-based management.

ENVR 2500. Biostatistics. (4 Hours)
Offers an overview of traditional and modern statistical methods used to analyze biological data using the free and open-source R programming environment. Lectures describe core statistical approaches and discuss their suitability for understanding patterns that arise at different levels of biological organization, from cellular processes to whole ecosystems. Supervised lab sessions offer students an opportunity to develop the R programming skills required to analyze the complex datasets that often emerge when addressing cutting-edge questions in biology. Topics include basic probability and sampling theory, experimental design, null hypothesis significance testing, t-tests and ANOVA, correlation and regression, likelihood, model selection, and information theory.

Corequisite(s): ENVR 2501
Attribute(s): NUpath Analyzing/Using Data, NUpath Formal/Quant Reasoning

ENVR 2501. Lab for ENVR 2500. (1 Hour)
Accompanies ENVR 2500. Offers supervised lab sessions demonstrating how topics covered in the lectures can be addressed in the R programming environment.

Corequisite(s): ENVR 2500

ENVR 2515. Sustainable Development. (4 Hours)
Focuses on the principles and practice of sustainable development, both as a way of looking at the interconnected world and an overarching framework for promoting economic development, social inclusion, and environmental stewardship. Students will study decades of local and global efforts aimed at developing economies, eradicating hunger and disease, and restoring and sustaining ecosystems for a large, and growing, population living on an increasingly altered planet and facing a changing climate. Along with lectures and discussions on core concepts, students will critically dissect the toughest questions and challenges of sustainable development through an online class blog and semester-long group projects.

Prerequisite(s): ENVR 1101 (may be taken concurrently) with a minimum grade of D- or ENVR 1400 (may be taken concurrently) with a minimum grade of D-
Attribute(s): NUpath Societies/Institutions, NUpath Writing Intensive

ENVR 2900. Special Topics in Environmental Studies. (4 Hours)
Studies various topics on environmental issues. May be repeated without limit.

ENVR 2990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVR 2991. Research in Marine and Environmental Sciences. (1-4 Hours)
Offers an opportunity to conduct introductory-level research or creative endeavors under faculty supervision.
ENVR 3125. Global Oceanic Change. (4 Hours)
Explores major changes in physical, biological, and chemical properties of the ocean over geological and human timescales. Includes origin and early evolution of the oceans; sea-level change; global warming; ocean acidification; the role of plate tectonics in driving long-term oceanic change; the role of atmospheric carbon dioxide in driving short-term oceanic change; tipping points in the oceans; snowball earth theory; marine pollution; oil exploration; and social, economic, and political implications of global oceanic change. Themes include differentiating drivers of change across multiple temporal and spatial scales; evaluating change from different and sometimes conflicting perspectives (social, economic, political, environmental); differentiating local and global change; and establishing linkages between physical, chemical, and biological processes in the ocean. Requires prior completion of one laboratory science course or permission of instructor.

Attribute(s): NUpath Natural/Designed World

ENVR 3150. Food Security and Sustainability. (4 Hours)
Discusses the science of sustainable agriculture, fisheries, and aquaculture. Examines the issues related to nutrition and hunger, food safety, and food production in the face of a changing climate with a scientific lens. Using the FAO Global Food Security and Strategy document and other peer-reviewed literature, compares the food issues in the United States with those in the developing world, including sub-Saharan Africa and Southeast Asia. Explores the many issues related to food production and environmental sustainability—including fertilizer use, GMOs, and pollution—and local examples of sustainable food production. Discusses the ways in which we can potentially remedy many of the issues involved in providing food for more than 7 billion people worldwide.

Prerequisite(s): EEMB 1101 with a minimum grade of D- or ENVR 1101 with a minimum grade of D- or ENVR 1110 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D- or SOCL 1246 with a minimum grade of D-

Attribute(s): NUpath Natural/Designed World, NUpath Writing Intensive

ENVR 3151. Food Sustainability in the Mediterranean - Abroad. (4 Hours)
Focuses on the Mediterranean diet, which serves as the framework for this course. Discusses the scientific evidence supporting/refuting this diet, then observes the food systems that comprise the diet. Uses museum evidence to deduce the composition of ancient diets and compares this to dietary changes over time using interviews with village locals. Explores production of olive oil, vegetables, and grains and discusses how industrial farming affects traditional agriculture and human health. Also focuses on fish and shellfish production with visits to aquaculture and marine research facilities to discuss how best to include seafood in the human diet while preserving a diverse marine environment. Through comprehensive writing and discussion, offers students an opportunity to more clearly understand the history of food in this region.

ENVR 3200. Water Resources. (4 Hours)
Offers students who wish to work in the area of water resources an opportunity to understand the issues related to water’s availability and behavior at the Earth’s surface. Topics covered include (1) the hydrologic cycle, including global and regional patterns of water movement; (2) characteristics of surface and groundwater systems, including the linkage between streams, rivers, lakes, wetlands, groundwater, and the sea; (3) water management issues and regulations that have been enacted to control the use of water as a resource; (4) water quality measures for surface water and groundwater; and (5) examples of water use conflicts and emerging water issues. Case studies include examples from California, New England, New York, the southwestern United States, China, Africa, and the Middle East.

ENVR 3201. Coastal Sustainability: Ecology and Coupled Human-Natural Systems in Southeast Asia. (4 Hours)
Accompanies ENVR 3202. The majority of the Earth’s population now lives in coastal cities, where people not only depend on ocean resources but are also experiencing ever-increasing threats from the ocean environment, especially global climate change. Explores the mechanisms by which coastal communities in Southeast Asia (Hong Kong and Malaysia) are facing these expanding challenges, including their impacts on coastal ecosystems. Using a comparative approach, explores the diverse challenges facing coastal societies. Offers students an opportunity to gain an in-depth understanding of coupled human-natural systems in Southeast Asia. Prior completion of an introductory course in ecology or environmental sciences is recommended.

Corequisite(s): ENVR 3202

ENVR 3202. Coastal Sustainability: The Blue Economy of the Gulf of Maine. (4 Hours)
Accompanies ENVR 3201. Examines the status of the the Gulf of Maine (GOM) and its future trajectory from a scientific and societal perspective. The GOM is the heart of the Blue Economy in New England and the Canadian Maritime provinces. Historically, cod drove the economies of GOM communities. Now lobster, coastal development, international shipping, wild scallops, aquacultured salmon and mussels, and coastal technology are transforming the region. But the GOM is under threat from global warming, sea-level rise, eutrophication, and invasive species, as coastal cities like Boston, Portland, and Halifax seek resilient sustainable solutions to these challenges. Prior completion of an introductory course in ecology or environmental sciences is recommended.

Corequisite(s): ENVR 3201
ENVR 3300. Geographic Information Systems. (4 Hours)
Studies how to use a geographic information system (GIS). Explores the practical application of GIS to support scientific and social inquiry, analysis, and decision making. Topics include spatial data collection; data accuracy and uncertainty; cartographic principles and data visualization; geographic analysis; and legal, economic, and ethical issues associated with using GIS. Investigates case studies from geology, environmental science, urban planning, architecture, social studies, and engineering. Provides extensive hands-on experience with a leading commercial GIS software package. Offers students an opportunity to conceive their own research problem that can be addressed using GIS and reach conclusions that are summarized in a professional report. Students who do not meet course prerequisites may seek permission of instructor.

Prerequisite(s): EEMB 1101 with a minimum grade of D- or ENVR 1101 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-

Corequisite(s): ENVR 3301
Attribute(s): NUpath Analyzing/Using Data, NUpath Creative Express/Innov

ENVR 3301. Lab for ENVR 3300. (1 Hour)
Accompanies ENVR 3300. Covers topics from the course through various experiments.

Corequisite(s): ENVR 3300

ENVR 3410. Environmental Geochemistry. (4 Hours)
Offers students who wish to work in the geosciences or environmental science and engineering fields, including on the land, in freshwater, or the ocean, an opportunity to understand the geochemical principles that shape the natural and managed environment. Seeks to provide a context for understanding the natural elemental cycles and environmental problems through studies in atmospheric, terrestrial, freshwater, and marine geochemistry. Topics include fundamental geochemical principles; environmental mineralogy; organic and isotope geochemistry; the global carbon, nitrogen, and phosphorous cycles; atmospheric pollution; environmental photochemistry; and human-natural climate change feedbacks. ENVR 3410 and CHEM 3410 are cross-listed.

Prerequisite(s): CHEM 1151 with a minimum grade of D- or CHEM 1161 with a minimum grade of D- or CHEM 1214 with a minimum grade of D- or CHEM 1220 with a minimum grade of D-

Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

ENVR 3415. Environmental Pollution: Fate and Transport. (4 Hours)
Offers a systematic approach to analyzing the fate and transport of pollutants within natural systems. Uses equilibrium modeling and reactive transport modeling to assess the predominant processes that control the movement and persistence of pollutants in water, soil, and air. Topics include mass transfer across multiple phases; physical, chemical, and biological transformations of substances; transport processes (diffusion, dispersion, advection, interphase mass transport); eutrophication of lakes; conventional pollutants in rivers and estuaries; groundwater contamination; and atmospheric deposition.

Prerequisite(s): CHEM 1151 with a minimum grade of D- or CHEM 1161 with a minimum grade of D- or CHEM 1214 with a minimum grade of D-

ENVR 3418. Geophysics. (4 Hours)
Studies the basic techniques of reflection and refraction seismology and earthquake analysis; gravity and magnetic surveying methods; radioactive decay principles and Earth's heat flow; and how information from these methods is used to interpret the nature and age of the Earth's surface and interior. Emphasizes near-surface exploration, data collection methods, data analysis, and using data to constrain mathematical models of the subsurface distribution of geologic units.

Prerequisite(s): (ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-); (MATH 1241 with a minimum grade of D- or MATH 1251 with a minimum grade of D- or MATH 1341 with a minimum grade of D-)

Attribute(s): NUpath Analyzing/Using Data

ENVR 3600. Oceanography. (4 Hours)
Presents an integrated overview of biological, chemical, physical, and geological processes operating in the world's oceans. Emphasizes understanding the fragility and resilience of marine systems in the face of human-driven perturbations such as habitat fragmentation, elevated sea surface temperature and acidification, non-native species, nonsustainable fishing and aquaculture, and coastal land use. Offers students an opportunity to prepare for further course work in both marine biology and in earth, oceans, and environmental change.

ENVR 3701. Energy in the Desert Ecosystem. (4 Hours)
Incorporates lectures, seminars, and visits throughout several institutions/organizations within the Arava Desert (Israel) to identify the various ways in which energy sustains life in this arid and harsh region of the world. Covers both the biological needs for energy acquisition and conservation of desert organisms, as well as technological advances in the utilization and storage of energy such as wind, solar, biomass, fuel cells, and hybrid systems, all within the context of living and exploiting the desert environment. Touches upon the environmental consequences of energy conversion and how renewable energy can reduce air pollution and global climate change.

ENVR 3990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVR 4000. Science Communication and Professional Development. (4 Hours)
Covers professional skills such as writing cover letters, crafting resumés, interviewing, creating a biographical sketch, and developing overall confidence by connecting to audiences. Science communication focuses on connecting with nonscientific audiences to convey complex scientific concepts and engaging diverse stakeholders to solve pressing societal problems using scientific approaches. Covers general principles of messaging, based on an understanding of how people learn and make decisions, using techniques such as narrative storytelling, visualizations, and theatrical improvisation and other art forms. Offers students an opportunity to develop tools to highlight their strengths, market their skills, explore potential jobs and career paths, and understand how to best prepare for those positions. Designed to integrate with ENVR 4050.

Corequisite(s): ENVR 4050
ENVR 4050. Solving Emerging Environmental Challenges through Capstone. (4 Hours)
Gathers students from across the various environmental and sustainability sciences concentrations to solve environmental problems that are of concern to various stakeholders. Students perform service-learning with a number of not-for-profit and government agencies to identify specific environmental challenges to tackle. Students work in teams that unite social scientists, sustainability experts, conservation biologists and ecologists, and physical scientists to bring the specific expertise gained during their concentration studies together to tackle pressing environmental challenges. Offers students an opportunity to provide solutions to the problems proposed by our stakeholders, as well as to learn leadership and communication skills needed to head up a large project and to thrive in a transdisciplinary environment.

Corequisite(s): ENVR 4000
Attribute(s): NUpath Capstone Experience

ENVR 4500. Applied Hydrogeology. (4 Hours)
Covers the origin, distribution, and flow of groundwater in permeable sediments and bedrock; hydrological and geological characteristics of aquifers; regional flow systems emphasizing rock structure, stratigraphy, and other aspects of the geological environment; principles of hydrogeologic mapping and analysis; and introduces well testing and well hydraulics. Uses methods of collecting data about the physical distribution and properties of water and its interaction with geologic materials in the subsurface, including its chemical composition, and mathematical models to interpret the direction and velocity of groundwater flow. Considers remediation strategies for dealing with contaminated water in the subsurface.

Prerequisite(s): (ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-); (MATH 1241 with a minimum grade of D- or MATH 1251 with a minimum grade of D- or MATH 1341 with a minimum grade of D-)
Corequisite(s): ENVR 4501
Attribute(s): NUpath Analyzing/Using Data

ENVR 4501. Lab for ENVR 4500. (1 Hour)
Accompanies ENVR 4500. Covers topics from the course through various experiments.

Corequisite(s): ENVR 4500

ENVR 4504. Environmental Pollution. (4 Hours)
Describes models and methods for predicting fate and transport of organic contaminants within and between environmental media, including molecular diffusion, transport across boundaries, and box models. Uses chemical structure and thermodynamic properties to predict physical processes that control the distribution of contaminants between the atmosphere, fresh and marine surface waters, groundwater, soils, sediments, and biota. Introduces concepts linking environmental chemistry with ecotoxicology, including bioaccumulation, food web models, and risk assessment. Uses case studies and real-world scenarios to illustrate important concepts. Offers students an opportunity to develop the tools and skills necessary to determine the fate of organic chemicals released to the environment.

Prerequisite(s): (CHEM 1161 with a minimum grade of D or CHEM 1214 with a minimum grade of D); (EEMB 1101 with a minimum grade of D- or ENVR 1101 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-)
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

ENVR 4505. Wetlands. (4 Hours)
Presents an interdisciplinary overview of the physical, biological, and cultural aspects of wetlands. Topics covered include definitions, classification systems, origins, human use, and natural processes of wetland environments. Offers students an opportunity to learn about wetland hydrology, soils, and vegetation and their relationship to ecosystem processes, societal values, and management. Includes reading and analyzing the scientific literature and conducting in-class activities.

Prerequisite(s): EEMB 1101 with a minimum grade of D- or ENVR 1101 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-
Attribute(s): NUpath Analyzing/Using Data

ENVR 4900. Earth and Environmental Science Capstone. (1 Hour)
Designed for students enrolled in concert with an approved 500–600-level environmental studies course (check with department office for up-to-date listings). Faculty help students to identify topics for individual research tailored to students’ interests and the course content. Provides an opportunity for reflection about what the student has learned in the major, in their NU Core course work, and experiential learning. Required components include writing with revision and an oral presentation at a departmentwide capstone seminar late in the semester.

Attribute(s): NUpath Capstone Experience, NUpath Writing Intensive

ENVR 4970. Junior/Senior Honors Project 1. (4 Hours)
Focuses on in-depth project in which a student conducts research or produces a product related to the student’s major field. Combined with Junior/Senior Project 2 or college-defined equivalent for 8-credit honors project. May be repeated without limit.

Attribute(s): NUpath Capstone Experience

ENVR 4971. Junior/Senior Honors Project 2. (4 Hours)
Focuses on second semester of in-depth project in which a student conducts research or produces a product related to the student’s major field. May be repeated without limit.

Prerequisite(s): ENVR 4970 with a minimum grade of D-
Attribute(s): NUpath Capstone Experience

ENVR 4990. Elective. (1–4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVR 4992. Directed Study. (1–4 Hours)
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

ENVR 4993. Independent Study. (1–4 Hours)
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

ENVR 4996. Experiential Education Directed Study. (4 Hours)
Draws upon the student’s approved experiential activity and integrates it with study in the academic major. Restricted to those students who are using the course to fulfill their experiential education requirement. May be repeated without limit.

Attribute(s): NUpath Integration Experience
ENVR 4997. Senior Thesis. (4 Hours)
Offers students an opportunity to prepare an undergraduate thesis under faculty supervision.

Attribute(s): NUpath Capstone Experience, NUpath Writing Intensive

ENVR 5115. Advanced Topics in Environmental Geology. (4 Hours)
Examines selected topics in geology through an understanding of the basic processes, materials, and evolution. Topics include basin analysis, landform evolution, volcanology, or regional geology. May be repeated without limit.

ENVR 5150. Climate and Atmospheric Change. (4 Hours)
Offers an in-depth view of the processes that drive change in Earth’s climate system. Examines the modern climate system and how and why climate changes through time. Introduces the tools used to explore past climates and changes, and explores the long-term and short-term controls on the climate system. Also introduces the application of climate models to develop future climate projections. Offers students an opportunity to obtain hands-on experience analyzing and interpreting climate data and model output.

Prerequisite(s): (ENVR 1200 with a minimum grade of D- or ENVR 2200 with a minimum grade of D-) or graduate program admission

ENVR 5190. Soil Science. (4 Hours)
Provides a description and evaluation of the physical, chemical, and biological properties of soils. Includes soil formation, soil types, and processes that occur in soil including the importance of these processes for the soil productivity and management of soil. Also covers sources, reactions, transports, and fates of chemical species in soils and associated water and air environments, as well as the chemical behavior of elements and compounds and the phenomena affecting natural and anthropogenic materials in soils.

Prerequisite(s): ENVR 1101 with a minimum grade of D- or ENVR 1200 with a minimum grade of D- or ENVR 2310 with a minimum grade of D- or graduate program admission

ENVR 5201. Geologic Field Seminar. (4 Hours)
Studies aspects of geology/environmental science associated with a particular field setting, in the classroom, followed by an intensive field investigation. Examples include carbonate petrology and reef ecology, then field studies in the Bahamas; glacial geology and volcanology, followed by field studies in Iceland; or stratigraphy of the U.S. Southwest, with field studies in the Grand Canyon. Focuses on using field observations and field data to interpret modern and ancient geologic processes. May be repeated without limit.

Attribute(s): NUpath Analyzing/Using Data, NUpath Integration Experience, NUpath Natural/Designed World

ENVR 5220. Ecosystem-Based Management. (4 Hours)
Introduces the principles and practice of ecosystem-based management. Covers how ecosystem-based management draws from social, economic, and ecological principles, as well as how these principles are fundamentally coupled. Begins by covering the evolution of resource management, from single-species to ecosystem-based approaches, including the strengths and challenges of each approach. Focuses on how ecosystem-based management has been applied to terrestrial, freshwater aquatic, and marine ecosystems, including challenges and successes of adopting this approach. Draws from a wide range of examples, including marine protected areas, terrestrial and marine spatial planning, and habitat restoration. Designed for upper-intermediate or advanced undergraduates and graduate students in environmental science and related fields.

Prerequisite(s): ENGW 1111 with a minimum grade of C or ENGW 1102 with a minimum grade of C or ENGL 1111 with a minimum grade of C or ENGL 1102 with a minimum grade of C or graduate program admission

Attribute(s): NUpath Writing Intensive

ENVR 5240. Sedimentary Basin Analysis. (4 Hours)
Presents the analysis of sedimentary basins based on detailed study of sedimentary petrology, sedimentary structures, and stratigraphic sequences and fossils.

Corequisite(s): ENVR 5241

ENVR 5241. Lab for ENVR 5240. (1 Hour)
Accompanies ENVR 5240. Lab work uses geologic sections, suites of sedimentary rocks and thin sections, and drill cores and bore hole logs to interpret and analyze the geologic history and environmental and economic potential of sedimentary basins.

Corequisite(s): ENVR 5240

ENVR 5242. Ancient Marine Life. (4 Hours)
Introduces invertebrate fossil morphology by study of fossil specimens of all major groups. Principles of paleoecology and evolutionary theory are illustrated by analysis of suites of fossil specimens.

Corequisite(s): ENVR 5242
Communication.

Students complete a participatory modeling project, including all steps in participatory modeling as a tool for both scientific inquiry and stakeholder engagement.

ENVR 5260. Geographical Information Systems. (4 Hours)
Examines geographical information systems (GIS), a way to input, store, analyze, and display spatial data (data with a geographic location). Introduces the major components and applications of this exciting new tool. Consists of two lectures and one laboratory period a week. Laboratory exercises introduce methods of data analysis as well as practical issues of how to manipulate various GIS software packages.

ENVR 5270. Glacial and Quaternary History. (4 Hours)
Examines the environmental conditions conducive to forming glaciers, the processes of ice movement, glacial erosion, modes of deposition, and the resulting landforms created under and around glaciers. Introduces the natural climate change of the ice age cycles and the major events of the Quaternary period.

Prerequisite(s): ENVR 1200 with a minimum grade of D- or ENVR 1400 with a minimum grade of D- or graduate program admission
Corequisite(s): ENVR 5271
Attribute(s): NUpath Analyzing/Using Data, NUpath Natural/Designed World

ENVR 5271. Lab for ENVR 5270. (1 Hour)
Accompanies ENVR 5270. Covers topics from the course through various experiments.

Corequisite(s): ENVR 5270

ENVR 5350. Sustainable Energy and Climate Solutions. (4 Hours)
Examines the role of sustainable energy on emissions from energy production and the resulting impacts on climate changes. Introduces current observations, predictions of future climate change, and the resulting impacts on ecological and human systems. Assesses past and current sources of U.S. energy-related and non-energy-related sources of greenhouse gases. Reviews sustainable energy alternatives and emission reduction strategies with a focus on comparing moderate and deep decarbonization strategies and the overall goal of reaching zero net emissions.

ENVR 5450. Applied Social-Ecological Systems Modeling. (4 Hours)
Covers the key frameworks, theories, and approaches for conducting social-ecological systems (SES) research. Involves topic and paper discussions focused on developing detailed knowledge and agility at describing the theoretical and applied foundations of interdisciplinary SES research. Includes semester-long projects to develop hands-on skills for conducting robust, methodologically sound studies of social-ecological systems. Particularly emphasizes participatory modeling as a tool for both scientific inquiry and stakeholder engagement. Students complete a participatory modeling project, including all steps of the scientific process, and have an opportunity to gain experience with research design, data collection, analysis, interpretation, and communication.

ENVR 5500. Advanced Biostatistics. (4 Hours)
Describes the advanced statistical concepts and approaches needed to analyze complex biological data. Examines the theoretical underpinnings of modern statistical methods and discusses their suitability for addressing questions from a variety of biological fields. Studies how to apply these methods using the R programming environment. Topics include a brief review of general linear models, likelihood and optimization, generalized linear models and survival analysis, model selection and regularization, generalized mixed-effects models, generalized additive models, Bayesian modeling, constrained and unconstrained ordination, supervised and unsupervised classification, ensemble modeling, and machine learning.

Prerequisite(s): ENVR 2500 with a minimum grade of C- or graduate program admission
Attribute(s): NUpath Analyzing/Using Data, NUpath Formal/Quant Reasoning

ENVR 5500. Sustainable Energy and Climate Solutions. (4 Hours)
Examines the role of sustainable energy on emissions from energy production and the resulting impacts on climate changes. Introduces current observations, predictions of future climate change, and the resulting impacts on ecological and human systems. Assesses past and current sources of U.S. energy-related and non-energy-related sources of greenhouse gases. Reviews sustainable energy alternatives and emission reduction strategies with a focus on comparing moderate and deep decarbonization strategies and the overall goal of reaching zero net emissions.

ENVR 5563. Advanced Spatial Analysis. (4 Hours)
Examines advanced concepts and techniques in GIS analysis and spatial statistics methods. Topics include spatial information theory, database theory, mathematical models of spatial objects, and GIS-based representation.

Prerequisite(s): ENVR 3300 with a minimum grade of D- or ENVR 5260 with a minimum grade of C-

ENVR 5600. Coastal Processes, Adaptation, and Resilience. (4 Hours)
Introduces the forcing and response of the built and natural coastal environment, including hurricanes and extratropical storms, wind waves, astronomical tides, storm surges, currents, sediment transport, and morphological changes. Seeks to provide an overview of the physical processes and interaction with human activity at the water and land interface, including anthropogenic, natural, and nature-based features for coastal defense. Uses examples and case studies of climate adaptation plans to illustrate alternatives to increase coastal resiliency. Emphasizes the challenges to developing resiliency solutions in urban coastal areas, where population growth coupled with sea-level rise and climate extremes exacerbate exposure of people and infrastructure to flood hazards.

ENVR 5584. Research. (1-4 Hours)
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

Environmental Studies Courses
Search ENVS Courses using FocusSearch (http://catalog.northeastern.edu/class-search/?subject=ENVS)

ENVS 1990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVS 2990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVS 3990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.
ENVS 4990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions.
May be repeated without limit.

ENVS 4991. Research. (4 Hours)
Offers an opportunity to conduct research under faculty supervision.

Attribute(s): NUpath Integration Experience

ENVS 4997. Senior Thesis. (4 Hours)
Offers students an opportunity to prepare an undergraduate thesis under faculty supervision.

Attribute(s): NUpath Capstone Experience, NUpath Writing Intensive