Earth and Environmental Sciences (ENVR)

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 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 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 2118. Ocean Literacies. (4 Hours)
Uses UNESCO's Seven Principles of Ocean Literacy to explore how scientific and technological understandings of the ocean inform cultural production—including novels, films, maps, and philosophy—and intersect with gender, race, and class. Offers students an opportunity to deepen understandings of key topics in marine science, develop skills in cultural and historical analysis, and collaborate with an external partner on a science and storytelling project.

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)
Corequisite(s): ENVR 2311
Attribute(s): NUpath Writing Intensive

ENVR 2311. Lab for ENVR 2310. (1 Hour)
Accompanies ENVR 2310. Cover topics from the course through various experiments.

Corequisite(s): ENVR 2310

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 2500. Biostatistics. (4 Hours)
Presents an overview of key statistical concepts and approaches for analyzing biological data. Focuses on the mathematical foundations of statistics. Topics include probability, probability distributions, experimental design, as well as statistical inference via point or interval estimation and hypothesis testing. Discusses classic parametric and nonparametric statistical tests for one or more population(s). Emphasizes the appropriateness of each test based on its assumptions, statistical power, and the structure of the data.

Corequisite(s): ENVR 2501, ENVR 2502
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 2502. Recitation for ENVR 2500. (0 Hours)
Accompanies ENVR 2500 and ENVR 2501. Covers various topics from the course. Offers students an opportunity to work interactively with instructors and other students to learn and apply the knowledge acquired in lecture and lab.

Corequisite(s): ENVR 2500, ENVR 2501

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 once.

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. May be repeated seven times.

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 1120 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 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 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- or ENVR 2200 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 oceans, 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.

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

ENVR 3435. Environmental Pollution: Fate and Transport. (4 Hours)
Provides a systematic approach to analyzing the fate and transport of pollutants within natural systems. Equilibrium modeling and reactive transport modeling are used 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 3540. Environmental Psychology. (4 Hours)
Incorporates themes from cognitive psychology and environmental science to examine how people understand the environment and their place in it and how this understanding varies with culture, informal experience, and formal education. Examines relations between environmental cognition, environmental attitudes, values and norms, and sustainable behavior.

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

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 3800. Plants and Society. (4 Hours)
Introduces the anatomy, physiology, ecology, diversity, and management of economically relevant plants. Applies plant biology to human nutrition, biofuels, wood, cloth, and medicines. Offers insight into cultural uses and values of plants across the globe. Also discusses traditional and new forms of plant management techniques, along with their advantages and disadvantages for sustainability.

Prerequisite(s): EEMB 1101 with a minimum grade of D- or ENVR 1101 with a minimum grade of D- or ENVR 1400 with a minimum grade of D-
Corequisite(s): ENVR 3801

ENVR 3801. Lab for ENVR 3800. (1 Hour)
Accompanies ENVR 3800. Offers students an opportunity to interact with plants on a weekly basis, while applying their observational, creative, identification, and technical skills. Introduces basic plant biology and physiology principles, along with their application for plant care. Focuses on the care techniques for common landscaping as well as household, edible, medicinal, and other economically important plants.

Corequisite(s): ENVR 3800

ENVR 3850. Sustainable Agriculture. (4 Hours)
Focuses on the natural science and management of sustainable agricultural systems. Introduces agricultural principles for soil management, pest management, and crop planning. Examines different agricultural systems including row cropping, indigenous food forests, vertical farming, and integrated crop-livestock systems. Evaluates the economic, policy, and social justice barriers to scaling sustainable agriculture. Discusses climate change resilience of sustainable agricultural systems.

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

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.

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.

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)
Offers students an opportunity to reflect about what they have learned in the major, in their coursework, and experiential learning. With help from faculty, students identify topics for individual research tailored to their interests and the course content. Requires writing with revision to produce a final capstone paper.

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 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 5000. Community Stakeholder Engagement in Environmental Management and Research. (4 Hours)
Introduces the history and theories of public participation in environmental policy settings to reflect on what kinds of participatory processes work best, for what purposes, and under which conditions. Environmental problems of the 21st century can be effectively addressed using processes that link sound scientific analysis with effective public deliberation. Applies principles studied to stakeholder and community engagement in science, research, or policy. Covers best practices for administering participatory processes and community engagement for community science, citizen science, or other participatory practices.

Attribute(s): NUpath Societies/Institutions

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 (PHYS 1151 with a minimum grade of D- ; PHYS 1152 with a minimum grade of D- ; PHYS 1153 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 1400 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 5202. Environmental Science Field Seminar Abroad. (4 Hours)
Offers an intensive environmental science field study experience associated with a particular off-campus geographic setting, such as Iceland, Newfoundland, Bahamas, etc. Offers students an opportunity to learn the principles of field study, to learn to recognize and record significant data, and to reach conclusions about a range of field-based problems being studied. May be repeated without limit.

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

ENVR 5210. Environmental Planning. (4 Hours)
Examines aspects of surface runoff from geomorphic and hydrologic perspectives. Develops methods for description and calculation of major river and drainage basin processes and applies the results to the planning process. Examines human modification of these systems—including urbanization, dams, and channelization—and applies this information to an understanding of regulatory processes. This is a writing-intensive course.

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 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.

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.

Attribute(s): NUpath Creative Express/Innov

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 5410. Human Behavior and Sustainability. (3 Hours)
Offers a graduate-level introduction to the interdisciplinary field of human behavior and sustainability sciences. Explores an emerging literature embracing the complexity of social-ecological systems to better engage with the processes that reinforce unsustainable pathways and those that might be leveraged toward more sustainable futures. Focuses on understanding how observations about the psychology of individuals and collectives, and their relationship to institutions, have been theorized in relation to the environment and the approaches and methodologies used to test and describe such relationships.

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)
Presents an overview of advanced statistical concepts and approaches for studying biological systems by explaining the mathematical underpinnings of statistical methods and demonstrating how to implement them in the R programming language. Topics include general(ized) linear models, likelihood, model selection, mixed-effects models, multivariate statistics, 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 5563. Advanced Spatial Analysis. (4 Hours)
Offers an in-depth evaluation of theoretical, mathematical, and computational foundations of geographic information systems (GIS). 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- 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 resilience 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 5610. Technology and the Blue Economy. (4 Hours)
Focuses on emerging technology and the global blue economy that generates trillions of U.S. dollars in economic activity. Introduces key sectors including global shipping, operations of port and harbors, fishing and aquaculture, tourism, ocean monitoring and exploration, finance models, energy, and minerals extraction. Examines challenges to a sustainable and equitable blue economy including global biodiversity loss, marine pollution, decarbonization, access to capital, and national security. Includes virtual field trips to companies and institutions involved in technology and the blue economy.

ENVR 5670. Global Biogeochemistry. (4 Hours)
Examines the biological, chemical, and physical interactions that shape our global environment. These interactions combine in the global biogeochemical cycles. Industrial emission of gases, use of fertilizers and plastics, and the expansion of cities are altering the biogeochemical cycling of the elements carbon, nitrogen, and phosphorus at rates unprecedented in the geological record. Uses lectures and the latest update to Chapter 6, "Carbon and Other Biogeochemical Cycles," of the International Panel on Climate Change report to explore the main interactions between human activity, biogeochemical change, and climate. Discusses primary literature to delve deeper into these interactions.

Attribute(s): NUpath Natural/Designed World

ENVR 5700. Streams and Watershed Ecology. (4 Hours)
Studies the physical, chemical, and biological processes in streams and surrounding watersheds. Explores the hydrology, structure, function, and biota of running waters and the landscape that supports them. Examines current and relevant issues in stream science and policy, including natural and anthropogenic disturbance, climate change, and management and restoration techniques in stream systems. Provides broad foundational knowledge on stream science, which offers students an opportunity to learn experimental techniques and employ them in the field. The first half of the course consists of lecture and discussion, while the second half is taught principally in the field.

Prerequisite(s): EEMB 2302 with a minimum grade of C- or ENVR 1400 with a minimum grade of C-

ENVR 5750. Urban Ecology. (4 Hours)
Investigates the myriad ways that natural systems intersect with human-dominated landscapes, including urban hydrology, nutrient cycling, and the distribution of organisms in cities. Urbanization is rapidly expanding with over half of humans currently inhabiting urban landscapes. The conversion of natural areas to human-dominated landscapes is resulting in the loss of biodiversity, habitat connectivity, and ecosystem services. It is also changing how we perceive and value natural systems. Evaluates the ecology *in* cities but also ecology *of* cities, including how cities integrate into larger landscapes; ecosystem service provisioning; and the biological, cultural, and psychological value of urban nature for people. Culminates by looking to the future of how urban spaces adapt to climate change, increasing populations, and other emerging issues.

Prerequisite(s): EEMB 2302 with a minimum grade of C- or ENVR 1101 with a minimum grade of C- or ENVR 1400 with a minimum grade of C- or graduate program admission

ENVR 5800. Climate Adaptation and Nature-Based Solutions. (4 Hours)
Examines ways of measuring ecological resilience, adaptation capacity, adaptation and mitigation strategies, and developing transformation pathways to new stable states. The effects of climate change are having wide-ranging impacts on people and nature. Climate mitigation and adaptation can slow or stop climate impacts and decrease their severity. Natural mitigation and adaptation strategies (nature-based solutions) offer sustainable approaches to respond to these challenges. Evaluates climate change impacts on natural systems and explores strategies that reduce and adapt to these changes, including impact assessment; evaluation of ecological health for ecosystems, habitats, communities, and populations; and response prioritization. Offers students an opportunity to build skills in informing and evaluating the potential for these strategies at local, regional, and global scales and opportunities to deploy these strategies.

Prerequisite(s): (ENVR 1101 with a minimum grade of C- or EEMB 2302 with a minimum grade of C-) or graduate program admission

ENVR 5984. Research. (1-4 Hours)
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

ENVR 6000. Professional Development for Co-op. (1 Hour)
Introduces the cooperative education program. Offers students an opportunity to develop job-search and career-management skills; to assess their workplace skills, interests, and values and to discuss how they impact personal career choices; to prepare a professional résumé; and to learn proper interviewing techniques. Explores career paths, choices, professional behaviors, work culture, and career decision making.

ENVR 6102. Environmental Science and Policy Seminar 2. (4 Hours)
Critically explores fundamental and modern theory, methodologies, and practices for conserving and managing coupled social-ecological systems (SES). Focuses on science and policy of environment management through the lens of coupled SES. Historically, the majority of studies focused on human-environment interactions have typically involved measuring and describing the negative impacts of human populations and development on natural ecosystems. More recently, however, environmental science and practice have experienced a paradigm shift to where now humans and the natural environment are recognized as tightly coupled systems. From an SES perspective, humans continue to shape the structure and function of ecosystems through both stressors and stewardship. However, a key advancement is the recognition that people and their behavior are directly influenced by structure, function, and services of ecosystems.

ENVR 6150. Food Security and Sustainability. (4 Hours)
Explores the science of sustainable food production around the world and examines the issues related to nutrition and hunger, food safety, and food production. Discusses issues such as population growth, climate change, and sustainability, which are presented as thematic topics. Also discusses issues such as soil health, genetically modified (and engineered) foods, water use, governmental food guidelines, and human health. Pulls focus on the thematic topics from scientific literature but also includes additional sources of information, such as gray literature, media coverage, documentaries, and popular nonfiction. Explores local examples of sustainable agriculture, including incentives in food security and sustainability in New England.

ENVR 6200. Water Resources. (4 Hours)
Focuses on the hydrologic cycle, including global and regional patterns of water movement; characteristics of surface and groundwater systems, including the linkage between streams, rivers, lakes, wetlands, groundwater, and the sea; water management issues and regulations that have been enacted to control the use of water as a resource; water quality measures for surface water and groundwater; and examples of water use conflicts and emerging water issues. Case studies of specific water challenges include examples from the United States, Asia, Africa, the Middle East, and Europe.

ENVR 6500. Biostatistics. (4 Hours)
Offers an in-depth overview of statistical methods used to analyze data, with a focus on the biological sciences as well as nonbiological applications. Covers probability theory, Bayes' theorem, hypothesis testing, derivations of statistical distributions, models used for inference with categorical and/or continuous data, linear models, model selection, information theory, and nonparametric methods in statistics. Offers students an opportunity to learn how to apply models to data in supervised lab sessions in the R programming environment.

Corequisite(s): ENVR 6501

ENVR 6501. Lab for ENVR 6500. (1 Hour)
Accompanies ENVR 6500. Introduces the core principles for programming in R, key functions, and application to real datasets.

Corequisite(s): ENVR 6500

ENVR 6954. Co-op Work Experience - Half Time. (0 Hours)
Provides eligible students with an opportunity for part-time work experience.

Prerequisite(s): MATH 6000 with a minimum grade of S

ENVR 6962. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

ENVR 6964. Co-op Work Experience. (0 Hours)
Provides eligible students with an opportunity for work experience. May be repeated without limit.

ENVR 8410. Special Topics in Human Behavior and Sustainability. (3 Hours)
Offers in-depth analysis of critical topics in human behavior and sustainability sciences. Specific topics vary by semester. May be repeated up to five times for a maximum of 18 semester hours.