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.

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.

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.

ENVR 1112. Environmental Geology. 4 Hours.
Investigates geologic processes such as flooding, volcanic eruptions, and earthquakes, as well as strategies for safer land use incorporating geologic information. Exercises completed and discussed in class offer hands-on experience with evaluating geologic factors that impact land use and formulating hazards mitigation strategies. Offers students an opportunity to increase their understanding of problems resulting from the interaction of humans with the geologic environment and how we can more appropriately interact with it.

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.

ENVR 1145. Volcanoes. 4 Hours.
Offers students an opportunity to understand how volcanoes work, why volcanoes occur, where volcanoes occur, and what their impacts have been throughout human history and prehistoric times. Also address strategies for safer land use around active volcanoes.

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.

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.

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 earth, the origin and evolution of life, the causes and effects of extinction, plate tectonics and mountain building, and climate change over earth history.

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.

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

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.

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

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.

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

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, Monte Carlo simulations, likelihood, generalized linear models, model selection, and information theory.

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.

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 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.

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.

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.

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

ENVR 3410. Environmental Geochemistry. 4 Hours.
Provides a context for understanding environmental problems through studies in atmospheric, terrestrial, freshwater, and marine geochemistry. Topics include aqueous geochemistry, environmental chemical analysis, nature and source of hazardous wastes (environmental chemistry, reduction, treatment and disposal), acid rain, ozone hole, nuclear winter, green engineering, and alcohol production.

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 are 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.

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

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.

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

ENVR 4504. Environmental Pollution. 4 Hours.
Surveys pollution in our atmosphere, on land, and in our oceans. Offers students an opportunity to develop the skills to understand the sources, processes, and fate of environmental contaminants in surface and groundwater, soils, sediment, and biota, with special focus on organic contaminants. Links environmental chemistry with ecotoxicology through an understanding of bioaccumulation, food web models, and risk assessment. Uses case studies and real-world scenarios to illustrate important concepts. Emphasizes innovative solutions for pollution remediation. Discusses current pollution issues and how to clearly communicate these issues to a broad audience. Students who do not meet course prerequisites may seek permission of instructor.

ENVR 4515. Sustainable Development. 4 Hours.
Focuses on the development of communities in an environmentally sustainable way and on the division of natural resources within these communities and the global system. Defines and discusses "sustainable development" and its global role today. Exposes students to a history of developmental methods while learning about the interconnectedness of development and the environment. Encourages students to draw conclusions about the environmental impacts of these methods and to consider more equitable uses of natural resources.

ENVR 4563. Advanced Spatial Analysis. 4 Hours.
Provides an in-depth evaluation of theoretical, mathematical, and computational foundations of geographic information systems (GIS). Topics include spatial information theory, database theory, mathematical models of spatial objects, and GIS-based representation. Examines advanced concepts and techniques in raster-based GIS and high-level GIS modeling techniques. May be repeated without limit.

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.

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.

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.

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.

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

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 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.

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.

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.

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.

ENVR 5230. Structural Geology. 4 Hours.
Focuses on the description and origin of rock structures, with emphasis on interpretation of the mechanics of deformation. Lab analyses of structural features and problems utilize geologic maps, structural models, stereograms, petrographic microscope, rock specimens, and field exercises.

ENVR 5231. Lab for ENVR 5230. 1 Hour.
Accompanies ENVR 5230. Covers topics from the course through various experiments.

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.

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.

ENVR 5242. Ancient Marine Life. 4 Hours.
Begins with a survey of major events, processes, and important invertebrate phyla preserved in the fossil record. This knowledge of paleontology is then utilized to evaluate evolutionary principles and the nature of function and adaptation in the history of life. Organization of populations into paleocommunities and their relationships to changes in environments through time permit the assessment and evaluation of paleoecology in Earth history.

ENVR 5243. Lab for ENVR 5242. 1 Hour.
Accompanies ENVR 5242. 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.

ENVR 5250. Geology and Land-Use Planning. 4 Hours.
Studies the causes and solutions of geologic environmental problems related to land use. Emphasizes geologic-based land-use planning solutions to problems related to landslides, ground subsidence, coastal erosion, stream erosion, flooding, soil erosion, and groundwater pollution. Assignments are based on actual examples requiring application of concepts covered in the course.

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.

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

ENVR 5400. Marine Science Policy and Ethics. 3 Hours.
Offers ethics training for a critical review of marine policies in the following topical areas: marine environmental ethics (conservation and preservation), conflicts of interest/research integrity, human subjects/mammal protections, ethical challenges in marine science modeling, ethics of fishing governance (marine conservation and regulations), sustainability models for marine sciences, data management, and new models of comanagement and community engagement with marine research. Reviews critical environmental policies affecting marine resources (NEPA, CERCLA, RCRA, Endangered Species, Marine Mammal Protection, and Oil Pollution acts, Magnuson-Stevens Act, etc.). Critically evaluates case studies and ethical review of coastal management for sustainability and pollution control, marine fisheries, and energy development.

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

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 6500. Biostatistics. 3 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.

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.

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