
Environmental Science

ENVS 1013 Introduction to Environmental Science 1

This course introduces students to the interdisciplinary nature of environmental science and the skills necessary for success in the discipline. It integrates fundamental science concepts from a number of disciplines (e.g., earth science, chemistry, biology, atmospheric science) and examines current environmental issues (e.g., global warming, acidification, deforestation, contaminants) within a multidisciplinary scientific context. Restricted to ENVS, ENGO, and ESST majors. *Antirequisite(s): ENVS 1643.*

ENVS 1023 Introduction to Environmental Science 2

This course is a continuation of the introduction to environmental science presented in ENVS 1013. Students approach issues of current environmental concern and develop interdisciplinary strategies for study and resolution. In addition, the overarching themes of environmental ethics, risk management and environmental policy are investigated. *Prerequisite(s): ENVS 1013 or permission of the instructor.*

ENVS 2523 Field Course: Environmental Science

Field techniques in environmental science, data analysis, and communication skills. Interdisciplinary approaches to field work and environmental analysis are incorporated into all exercises and discussions. Specific skills include geological mapping, field sampling, quality assurance/quality control, water quality measurement, and development of final report. (10-day course at the end of winter term). *Prerequisite(s): Minimum second-year standing in Environmental Science, ENVS 1013; GEOL 1023.*

ENVS 3113 Legal Issues in Environmental Science

A course designed to explore the constitutional, legislative and regulatory context of environmental law from a science perspective. A comparison and contrast of international environmental law responses for specific issues will be conducted in relation to Canada's treaty obligations and the common law system. *Prerequisite(s): 6h science and third-year standing.*

ENVS 3423 Environmental Impact Assessment

An interdisciplinary approach to the principles, practices, and methods involved in environmental impact assessments. Impacts covered include socio-economic, soils and geology, ecology, air, water, climate, and noise. *Prerequisite(s): Third-year standing in ENVS, ENGO, GEOL or permission of the instructor.*

ENVS 3503 Borders, Scale and the Environment

This course draws on interdisciplinary geographic perspectives to explore the spatial dimensions of environmental decision-making. It provides students with the tools to a) think critically about interactions between social and biophysical systems, and b) understand critical perspectives on borders and scale. Topics include state/nature relations, ecosystem management, local/global interactions, transboundary resource governance, and the politics of protected areas. *Prerequisite(s): Open to all ESST and ENVS majors who have completed 54h. Antirequisite(s): Credit can be obtained for only one of ENVS 3503 or ESST 3503.*

ENVS 3513 Climate Change for Environmental Practitioners

A broad-ranging study of the causes and effects of changing climate incorporating the physical basis, historical record and anticipated future impact of the changing atmosphere. Investigation of the current public perception of global warming and its effects. Examination of the political, economic, and cultural frameworks within which climate-changing human activity, mitigation, and adaptation take place. *Prerequisite(s): 54h university credits.*

ENVS 4013 Environmental Science Project

An independent study course in which students conduct literature, laboratory or field investigations on some particular issue in Environmental Science. The work must be sponsored and supervised by a member of the department. Students participate in planning the experiments and developing suitable procedures and techniques. *Prerequisite(s): Permission of the Department.*

ENVS 4023 Special Topics in Environmental Science

Selected current topics on environmental issues. *Prerequisite(s): Third-year standing in environmental science or permission of the Department.*

ENVS 407T Honours Thesis 1

This course requires the student to propose and carry out an original study and submit and defend a thesis. As a component of an interdisciplinary degree, the thesis should reflect an interdisciplinary approach to the issue under study. Prior to registering in ENVS 407T/ENVS 408T, students should normally have completed a thesis proposal and successfully established their ability to complete interdisciplinary work. *Prerequisite(s): Completion of the first three years (90h) of the BScH ENVS program; minimum CGPA of 3.00.*

ENVS 408T Honours Thesis 2

This course requires the student to propose and carry out an original study and submit and defend a thesis. As a component of an interdisciplinary degree, the thesis should reflect an interdisciplinary approach to the issue under study. Prior to registering in ENVS 407T/ENVS 408T, students should normally have completed a thesis proposal and successfully established their ability to complete interdisciplinary work. *Prerequisite(s): ENVS 407T, completion of the first three years (90h) of the BScH ENVS program; minimum CGPA of 3.00.*

ENVS 4423 Communication and Critical Analysis in Environmental Science

Communication skills in environmental science are honed through written, oral, debate, and group negotiation assignments. Multidisciplinary topics in environmental science are critically analysed through these exercises. Learning objectives include the

enhancement of oral and written communications, critical analysis, project management, and negotiation skills. The importance of these skills to employment and professionalism in communications is emphasized through class assignments. *Prerequisite(s): Third or fourth-year standing in ENVS or ENGO program.*

ENVS 4613 Contaminants in the Environment

This course will examine the historical release, fate, and risk assessment of chemicals in ecosystems. Lectures will cover: (i) the major classes of chemical contaminants; (ii) factors affecting contaminant fate in ecosystems (ii) methods of ecological risk assessment for contaminants (toxicity, persistence, bioaccumulation, and long-range transport). Laboratory exercises will explore methods of assessing contaminant fate. *Prerequisite(s): CHEM 1023 or CHEM 1123.*

Geology

GEOL 1013 Our Dynamic Earth

An introduction to the Earth; its composition, internal structure, external features, and physical evolution. The concepts of sea-floor spreading and plate tectonics provide a framework for the origin and development of continents, oceans, mountains and volcanoes, and lead to an appreciation of an evolving, dynamic Earth. Field trips required. (3h lab).

GEOL 1023 Earth History: Global Change Through Time

Changes in the Earth's continents, oceans, biosphere, and atmosphere over the past 4.6 billion years. The application of understanding of the past as a key to future global changes. Other topics include mass extinctions, plate tectonics, paleomagnetism, geologic dating, mountain-building and mineral resources. (3h lab). *Prerequisite(s): GEOL 1013 or equivalent with a minimum grade of C-.*

GEOL 1033 General Oceanography

Offshore and deep-water oceanography, emphasizing an interdisciplinary approach and including geological, biological, physical and chemical aspects. History of oceanography; exploration techniques, instruments and vessels; origin of oceans and ocean basins; physiography of the ocean basins; deep-sea sediments; continental drift, sea-floor spreading and plate tectonics; marine volcanism; waves, tides and ocean currents; climatology and sea-level changes; marine ecology; marine resources.

GEOL 1073 Natural Disasters

Natural disasters, their causes and effects and the science that underlies decision-making, prediction, and remediation. Topics include volcanoes, earthquakes, tsunamis, rivers and flooding, mass wasting and erosion, subsidence, coastal hazards, severe weather, climate change, impacts and extinctions.

GEOL 2043 Techniques in Petrology and Stratigraphy

Origin, occurrence, composition, and classification of igneous, sedimentary, and metamorphic rocks. An integrated overview of petrogenetic processes in a plate tectonic framework, including magma genesis, clastic and carbonate depositional processes, stratigraphic principles, and metamorphic zones and facies. Laboratory study of rocks in hand sample and thin section. (3h lab). *Prerequisite(s): GEOL 2133 with a minimum grade of C-; Prerequisite or Corequisite(s): GEOL 1023 with a minimum grade of C-.*

GEOL 2083 Field Methods

Held each spring for twelve days, focusing on field work and processing of field data to familiarize students with techniques of geological mapping. Involves electronic and manual measurement of field data including use of GPS instruments and laptop computers and subsequent preparation of maps, sedimentary sections, and cross-sections in paper and digital form. *Prerequisite(s): GEOL 2043 with a minimum grade of C- or permission of the Department. Corequisite(s): GEOL 2043 with a minimum grade of C- or permission of the Department.*

GEOL 2133 Mineralogy

Crystal symmetry and structure. Mineral chemistry, physical properties, associations, and uses. Identification of common minerals in hand sample. X-ray diffraction, transmitted light optical theory, and introduction to the petrographic microscope. (3h lab). *Prerequisite(s): GEOL 1013 with a minimum grade of C- (corequisite with Departmental permission). Corequisite(s): CHEM 1013.*

GEOL 2213 History of Life

The morphology, classification and evolution of the major groups of animals and plants in the fossil record. Emphasis will be on invertebrate paleontology, but attention will be given to the origin of life, Precambrian fossils, trace fossils, micro-fossils, fossil algae, vascular plants, lower vertebrates, dinosaurs and man. Laboratory work will include a systematic survey of the major groups of organisms having a fossil record. (3h lab). *Prerequisite(s): BIOL 1123 or GEOL 1023 with minimum grades of C-.*

GEOL 2703 Applied Geomorphology

Basic concepts in geomorphology including fluvial systems, continental glaciation, coastal processes, mass wasting, soil development, strength of materials, weathering, periglacial geomorphology, and airphoto interpretation. Emphasis will be on the environmental application of these concepts. Laboratory work will concentrate on airphoto interpretation and mini-projects related to some of these themes. (3h lab). *Prerequisite(s): GEOL 1013 with a minimum grade of C-.*

GEOL 2753 Atmosphere, Weather, and Climate

The composition, structure, and dynamics of the atmosphere; weather, climate, and biogeographic patterns; microclimatology; paleoclimates, paleogeography, and extinctions; human effect on air quality; climate change. (3h lab). *Prerequisite(s): Second-year standing.*

GEOL 3103 Introduction to Geochemistry

Investigation of chemical principles involved in geologic processes, emphasizing those acting on the surface and in near-surface environments. Topics include weathering, mineral exploration and environmental geochemistry applications. May be offered in alternate years. (3h lab). *Prerequisite(s): GEOL 2133 with a minimum grade of C-; Prerequisite or Corequisite(s): CHEM 1023.*

GEOL 3303 Sedimentary Geology

Study of clastic, chemical and biogenic sedimentation and diagenetic processes, sedimentary environments and facies and reservoir development. Field and laboratory techniques for the analysis, interpretation and classification of sediment and sedimentary rock textures, compositions and structures. (3h lab). *Prerequisite(s): GEOL 2043 with a minimum grade of C-.*

GEOL 3403 Igneous Petrology

The origin of magmas, their evolution, and crystallization. Igneous provinces and the relation between igneous activity and tectonics. Patterns of igneous activity through geological time. Laboratory studies of classical and local igneous rock suites. (3h lab).

Prerequisite(s): GEOL 2043 with a minimum grade of C-.

GEOL 3503 Metamorphic Geology

The mineralogical, textural, and structural characteristics of metamorphic rocks and the development of metamorphic facies. Contact and regional metamorphism, metasomatism, and anatexis are considered in detail. Current ideas relating metamorphism and tectonic setting provide the framework. Laboratory studies of classical and local metamorphic rock suites. (3h lab). *Prerequisite(s): GEOL 2043, GEOL 3603 with minimum grades of C-; GEOL 3403 recommended.*

GEOL 3603 Structural Geology and Tectonics

Rock structures and their geometric representation. Principles of stress and strain applied to brittle and ductile rock deformation. Fractures, faults, folds, and foliations: classification and mechanisms of formation. Plate boundary and intraplate tectonics. Practical work includes map interpretation, graphic and computer techniques for analyzing structural data, and field studies of deformed rocks. (3h lab). *Prerequisite(s): GEOL 2043 with a minimum grade of C-.*

GEOL 3723 Hydrogeology

Groundwater as part of the hydrologic cycle. Physical aspects of water movement in geologic materials - both saturated and unsaturated. Groundwater resource mapping and exploitation. Groundwater chemistry and biology: drinking water quality, contamination and associated health concerns. Exposure to laboratory and field techniques for groundwater monitoring. Field trips may be required. (3h lab). *Prerequisite(s): GEOL 2703 with a minimum grade of C-.*

GEOL 3733 Satellite Remote Sensing and Image Analysis

An introduction to the principles, practices and applications of satellite remote sensing. Electromagnetic spectra, satellite platforms, image enhancement, image classification and interpretation. Environmental and resource applications will be discussed. Laboratory work focuses on using image analysis programs to analyze satellite imagery. (3h lab). *Prerequisite(s): GEOL 2703 or BIOL 2033, with a minimum grade of C-, and permission of the instructor.*

GEOL 3823 Exploration and Environmental Geophysics

Principles and applications of geophysical methods used by the exploration and environmental geoscientist, including seismic, magnetic, gravimetric, electromagnetic, electric, and radiometric methods. May be offered in alternate years. *Prerequisite(s): GEOL 2043 with a minimum grade of C-.*

GEOL 3843 Energy Resources in Earth Science

Overview of non-renewable and renewable sources of energy associated with earth processes and materials, including carbon-based, geothermal, nuclear, tidal, solar, wind, and hydroelectric energy sources, generation, transmission, and storage. Topics also include processes and environments of formation of the required materials, exploration for, production of, and temporal supply and demand for these resources (3h lab). *Prerequisite(s): GEOL 1013, GEOL 1023.*

GEOL 4013 Global and North American Geology

Global tectonics, processes at convergent plate margins, worldwide Phanerozoic orogenic belts and Precambrian tectonics. An integrative study of the geological evolution of North America, including stratigraphy, structural development, and Quaternary history but with an emphasis on comparative tectonic evolution of the Cordilleran, Appalachian, and Precambrian orogenic belts. Laboratory work includes map interpretation and petrological studies of rock suites (3h lab). *Prerequisite(s): GEOL 3603 with a minimum grade of C-.*

GEOL 407T Honours Thesis 1

GEOL 408T Honours Thesis 2

Prerequisite(s): GEOL 407T.

GEOL 4083 Field School

Held for about 12 days preceding fall term and continuing into the term. Advanced field methods of geological mapping with preparation of a map and report. *Prerequisite(s): GEOL 2083, GEOL 3603, both with a minimum grade of C-.*

GEOL 4303 Carbonate Sedimentology Field School

This course focuses on the sedimentology, oceanography, and diagenesis of carbonate sediments and rocks of Bermuda. Investigation of Nova Scotia limestones introduces key concepts. Lectures and field exercises focus on carbonate depositional environments and the development of groundwater and hydrocarbon reservoirs in limestone. Assignments use sedimentologic, ecologic, and chemical techniques to understand the deposition of carbonate facies. *Prerequisite* GEOL 3323 or permission of the instructor.

GEOL 4713 Glacial Geology

A treatment of specific topics in glacial geoscience with particular emphasis on environmental change during the Quaternary time period. Topics covered will include glaciations, glacial landscapes, glacial hazards, paleoclimate, Quaternary dating techniques, human activity, and exploration in glaciated terrain. *Prerequisite(s):* Permission of the instructor.

GEOL 4803 Mineral Deposits

The nature, occurrence and origin of mineral deposits, with emphasis on metallic deposits. (3h lab). *Prerequisite(s):* GEOL 3403, GEOL 3603, both with a minimum grade of C-.

GEOL 4813 Mineral Exploration

Introduction to mineral exploration techniques, economic deposit evaluation strategies, and mining and processing methods. Offered only when the corresponding graduate course GEOL 5883 is taught. (3h lab). *Prerequisite(s):* GEOL 4803 with a minimum grade of C-.

GEOL 4833 Exploration and Environmental Geochemistry

Geochemical principles and techniques applied in mineral exploration and environmental geochemistry. Includes theory of dispersion, natural precipitation barriers, solubility, sorption and the design and execution of geochemical surveys, analysis of samples, and interpretation of results. Offered only when the corresponding graduate course (GEOL 5833) is taught. *Prerequisite(s):* GEOL 3103, GEOL 4803, or CHEM 2853, with a minimum grade of C- or permission of the instructor.

GEOL 4853 Geochemical Material Transfer

Introduction to the theory of material transfer and its use in interpreting geochemical and mineralogical controls on rock composition and formation, including water-rock and melt-crystal reactions and physical grain fractionation. Interpretation of results using petrologic hypothesis testing and error propagation. *Corequisite(s):* GEOL 3403 or GEOL 3503. Offered only when the corresponding graduate course (GEOL 5823) is taught.

GEOL 4913, GEOL 4923, GEOL 4933 Special Projects

Guided study in an area of particular interest under the direction of a staff member. Such work may be based on lecture, field, laboratory or library study, or all four, focusing on aspects of earth science not normally covered in the scheduled course offerings. The student may have responsibility in programming the research in addition to its conduct. *Prerequisite(s):* Permission of the Department.