

# 2013-2014 Graduate Calendar

The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2013-2014 academic years, including the Summer Semester 2013, Fall Semester 2013 and the Winter Semester 2014.

For your convenience the Graduate Calendar is available in PDF format.

If you wish to link to the Graduate Calendar please refer to the Linking Guidelines.

The University is a full member of:

- The Association of Universities and Colleges of Canada

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## Disclaimer

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The Office of Graduate Studies has attempted to ensure the accuracy of this on-line Graduate Calendar. However, the publication of information in this document does not bind the university to the provision of courses, programs, schedules of studies, fees, or facilities as listed herein.

## Limitations

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The University of Guelph reserves the right to change without notice any information contained in this calendar, including any rule or regulation pertaining to the standards for admission to, the requirements for the continuation of study in, and the requirements for the granting of degrees or diplomas in any or all of its programs.

The university will not be liable for any interruption in, or cancellation of, any academic activities as set forth in this calendar and related information where such interruption is caused by fire, strike, lock-out, inability to procure materials or trades, restrictive laws or governmental regulations, actions taken by the faculty, staff or students of the university or by others, civil unrest or disobedience, Public Health Emergencies, or any other cause of any kind beyond the reasonable control of the university.

The University of Guelph reaffirms section 1 of the Ontario Human Rights Code, 1981, which prohibits discrimination on the grounds of race, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, handicap, age, marital status or family status.

The university encourages applications from women, aboriginal peoples, visible minorities, persons with disabilities, and members of other under-represented groups.

# Introduction

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## Collection, Use and Disclosure of Personal Information

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Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) [http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90f31\\_e.htm](http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90f31_e.htm). This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. Certain personal information is disclosed to external agencies, including the Ontario Universities Application Centre, the Ministry of Training, Colleges and Universities, and Statistics Canada, for statistical and planning purposes, and is disclosed to other individuals or organizations in accordance with the Office of Registrarial Services Departmental Policy on the Release of Student Information. For details on the use and disclosure of this information call the Office of Registrarial Services at the University at (519) 824-4120 or see <http://www.uoguelph.ca/registrar/registrar/index.cfm?index>.

## Statistics Canada - Notification of Disclosure

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For further information, please see Statistics Canada's web site at <http://www.statcan.gc.ca> and Section XIV Statistics Canada.

## Address for University Communication

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Depending on the nature and timing of the communication, the University may use one of these addresses to communicate with students. Students are, therefore, responsible for checking all of the following on a regular basis:

### Email Address

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The University issued email address is considered an official means of communication with the student and will be used for correspondence from the University. Students are responsible for monitoring their University-issued email account regularly.

### Home Address

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Students are responsible for maintaining a current mailing address with the University. Address changes can be made, in writing, through the Office of Graduate Studies.

## Name Changes

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The University of Guelph is committed to the integrity of its student records, therefore, each student is required to provide either on application for admission or on personal data forms required for registration, his/her complete, legal name. Any requests to change a name, by means of alteration, deletion, substitution or addition, must be accompanied by appropriate supporting documentation.

## Student Confidentiality and Release of Student Information Policy Excerpt

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The University undertakes to protect the privacy of each student and the confidentiality of his or her record. To this end the University shall refuse to disclose personal information to any person other than the individual to whom the information relates where disclosure would constitute an unjustified invasion of the personal privacy of that person or of any other individual. All members of the University community must respect the confidential nature of the student information which they acquire in the course of their work.

Complete policy at <http://www.uoguelph.ca/policies>.



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## Environmental Sciences

The School of Environmental Sciences offers program of study leading to MSc, MES, PhD, and Graduate Diploma degrees. Graduate Studies in the Environmental Sciences programs are designed to train people to work independently and imaginatively with a high level of technical skill and scientific acumen. It is expected that the graduates of the SES program will provide leadership in research and training in academic, government, and industrial sectors of society and who will participate in the formulation and implementation of constructive national and international science policy.

### Administrative Staff

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### Graduate Faculty

#### Madhur Anand

BSc, PhD Western Ontario - Professor

#### Emmanuelle Arnaud

BA McMaster, MSc UBC, PhD McMaster - Associate Professor

#### Michael A. Dixon

BSc, MSc Mount Allison, PhD Edinburgh - Professor

#### Kari Dunfield

BSc Calgary, MSc, PhD Saskatchewan - Associate Professor

#### Susan Glasauer

BSc, MSc California, PhD Munich - Associate Professor

#### Paul H. Goodwin

BS Villanova, MSc Minnesota, PhD California (Davis) - Professor

#### Andrew M. Gordon

BS&F New Brunswick, PhD Alaska - Professor

#### Robert Gordon

BSc Guelph, MSc McGill, PhD Guelph - Professor and Dean, Ontario Agricultural College

#### Ernesto Guzman

DVM Mexico, MSc, PhD California (Davis) - Professor

#### Marc Habash

BSc Toronto, MSc Western, PhD Guelph - Assistant Professor

#### Beverley Hale

BSc, MSc Toronto, PhD Guelph - Professor and Associate Dean (Research & Innovation), Ontario Agricultural College

#### J. Christopher Hall

BSc, MSc Guelph, PhD Alberta - Professor

#### Rebecca Hallett

BSc Toronto, MPM, PhD Simon Fraser - Associate Professor

#### Richard J. Heck

BSA, MSc, PhD Saskatchewan - Associate Professor

#### Thomas Hsiang

BSc, MSc British Columbia, PhD Washington - Professor

#### Shelley L. Hunt

BSc, PhD Guelph - Associate Professor

#### John D. Lauzon

BSc, MSc, PhD Guelph - Associate Professor

#### Hung Lee

BSc British Columbia, PhD McGill - Professor

#### Steven A. Marshall

BSc (Agr) Guelph, MSc Carleton, PhD Guelph - Professor

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BSc (Agr), PhD Guelph - Professor

#### Jonathan A. Newman

BA, PhD State Univ. of New York - Professor and Director, School of Environmental Sciences

#### Ivan O'Halloran

BSc, MSc Guelph, PhD Saskatchewan - Associate Professor

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BS Duke, PhD Kansas - Professor

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BSc, MSc Western, PhD Guelph - Associate Professor

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BSc, PhD Toronto - Associate Professor and Associate Dean (Academic), Ontario Agricultural College

#### Cynthia D. Scott-Dupree

BSc Brandon, MPM, PhD Simon Fraser - Professor

#### Paul K. Sibley

BSc, MSc Guelph, PhD Waterloo - Professor and Associate Director, Graduate Studies, School of Environmental Sciences

#### Jack T. Trevors

BSc, MSc Acadia, PhD Waterloo - Professor

#### Laura Van Eerd

MSc, PhD Guelph - Associate Professor

#### R. Paul Voroney

BSc Calgary, MSc, PhD Saskatchewan - Professor

#### Claudia Wagner-Riddle

BSc, MSc Sao Paulo, PhD Guelph - Professor and Associate Director, School of Environmental Sciences

#### Jon S. Warland

BSc Cornell, MSc UBC, PhD Guelph - Associate Professor

### MSc Program

The objective of the MSc program is to develop and train graduate students that possess a high level of knowledge about the field of environmental science, expertise in specific aspects of environmental science (their thesis research focus), training in laboratory and field techniques, and excellence in writing and oral communication. With these skills, MSc students will possess a strong foundation on which they can be highly successful in science-related positions in government, industry, and consulting, or carry out high quality research at the PhD level.

### Admission Requirements

The School's admission standard for the MSc program is the same as the University and requires a four-year, honours science degree with a minimum B- (70-72%) average during the final two years (4 semesters) of full time undergraduate study. Meeting the minimum requirement (B-) does not guarantee entrance; depending on other criteria (e.g., letters of reference, standardized test scores, academic background relevant to the area to which the applicant has applied, degree of work experience in related fields of study) students may be considered for admission with provisional status. Students on provisional status must obtain a "B" average (70%) in at least two graduate courses during their first two semesters of study to continue in the program. Provisional students will be funded at the same level as regular students.

### Degree Requirements

The MSc thesis program requires:

- At least 1.5 graduate course credits, including one mandatory 0.25 credit course (Graduate Seminar).
- Completion and defense of a thesis on research carried out under the direct supervision of a core faculty member.

The thesis and the oral defense of the thesis are evaluated on a pass/fail basis. An acceptable MSc thesis consists of a defensible account of the student's research. The project is expected to represent a well-defined research problem, or hypothesis, and should be planned such that the clarity of the underlying rationale, the appropriateness of the technical approach, the research, and the critical evaluation of the results could normally be completed and the thesis defended within six semesters.

### MES Program

The MES (coursework Master's) degree enables students to study the most recent theoretical and technical advances in the environmental sciences through multidisciplinary teaching and research. There are two options to the MES in Environmental Sciences: by coursework + research project and by coursework-only. The MES will promote critical thinking and enhance oral and written communication skills so that graduates can excel in industry, government and other sectors of civil society (e.g., environmental risk assessors/managers, political advisors on policy/law issues in government, senior positions in national and international agencies, etc.).

### Admission Requirements

This degree is subject to the same entry requirements as the thesis-based MSc.

### MES Degree Requirements

#### Coursework + Project Option

Candidates must complete a minimum of 4.0 credits

- ENVS\*6500 [1.0] The Environmental Science Research Project
- ENVS\*6501 F [0.5] Advanced Topics in Environmental Science
- ENVS\*6502 W [0.5] Seminar in Environmental Science
- Two additional credits from Environmental Sciences courses

The research project may be completed at the University or as part of a placement with an approved non-academic agency. The project may include analysis of a data set (derived from lab, field, or computer simulation) related to the specialization chosen by the student including analyses and interpretations of relevant data (the student may or may not be involved in collecting the data), or major, critical literature review. The outcome of the research project will be presented to the department as a seminar and evaluated as a pass/fail.

### Coursework option

Candidates must complete a minimum of 4.0 credits

- ENVS\*6501 F [0.5] Advanced Topics in Environmental Science
- ENVS\*6502 W [0.5] Seminar in Environmental Science
- Three additional credits from Environmental Sciences courses

Students in either option may select courses from other departments on campus but are advised that access may be restricted and permission may be required by course instructors.

### PhD Program

The objectives of the PhD program are to develop highly competent, independent, creative, and critical scientists. Doctoral students of the SES graduate program will provide leadership as scholars in academic institutions, as managers and officers in the industrial research and development sector, research and policy branches within the government sector and in other social institutions. Research in the PhD program is expected to be original and novel, contribute significantly to the relevant research field, and published in high-quality peer-reviewed journals.

The PhD program has three areas of specialization:

- **Earth and Atmospheric Sciences** – Research areas include: soil biology and soil physics, sedimentology, geobiology, soil chemistry, geochemistry, atmospheric chemistry and air quality, soil and land resource management
- **Ecosystem Science and Biodiversity** – Research areas include: toxicology, pest management, management of agroecosystems, microbiology, forest systems, agroforestry, climate change biology, ecology, and insect systematics and taxonomy
- **Plant & Environmental Health** – Research areas include: plant biology, plant pathology, epidemiology, soil-plant interactions, biotechnology, molecular biology, forest systems, agroforestry, and climate change biology

### Admission Requirements

Admission to the PhD program is generally restricted to students with a recognized MSc degree in a related field obtained with a minimum academic standing of “A-“ (≥80%) in their postgraduate studies. Students who meet the minimum University requirement (73-76%) but not the School requirement (≥80%) may be considered depending on other criteria (e.g., letters of reference, standardized test scores, academic background relevant to the area to which the applicant has applied, degree of work experience in related field of study) for admission with provisional status. Students on provisional status must obtain an “A-“(≥80%) average in at least two graduate courses during their first two semesters of study to continue in the program. Provisional students will be funded at the same level as regular students. In exceptional cases, students may enter the PhD program directly from a BSc (Hons) if they have the minimum requirements as defined by the Office of Studies, University of Guelph.

### Degree Requirements

The PhD program requires:

- Completion of one mandatory 0.25 credit course (Graduate Seminar).
- Successful completion of a qualifying exam within five semesters of first registration in the program
- Successful defense of a thesis describing original research, carried out under the direct supervision of a core faculty member.

In the PhD program, the qualifying exam, thesis and the oral defense of the thesis are evaluated on a pass/fail basis. An acceptable PhD thesis consists of an authoritative report of the student's research. The project is expected to represent a well-defined research problem, or hypothesis, and should be planned such that the research could normally be completed and the thesis defended in nine semesters (12 semesters for those students transferring from the MSc program). The research described in the thesis must represent a significant contribution to knowledge in that field. Emphasis is therefore placed on the quality of the presentation, maturity in scholarship, breadth and depth of the work, and critical judgement. Successful completion of the PhD thesis occurs when the research is judged to be sufficiently meritorious to warrant publication in reputable, peer-reviewed journals in its field. PhD students are normally expected to have published, or have “in-press”, one or more papers in peer-reviewed journals prior to the defense. In cases involving intellectual property, it is recognized that publication may not always be immediately possible. In such cases, a Pass will require that the committee is satisfied that, in their opinion, the work is of sufficient quality and originality that it would meet the standards for peer-reviewed publications.

## Graduate Diploma Program

The objective of the Graduate Diploma is to provide highly focused training, education, and practical experience in Environmental Sciences. The Graduate Diploma is well-suited to recent undergraduate students, graduate students, and professionals seeking enhanced practical knowledge and experience associated with the application of current technologies and methods.

### Admission Requirements

The minimum requirement for admission to the Graduate Diploma in Environmental Sciences is a baccalaureate, in an honours program or the equivalent, from a recognized university or college. The applicant must have achieved an average standing of at least second-class honours ('B-' standing) in the work of the last four semesters or the last two undergraduate years (full-time equivalent). The program directors may waive some requirements for students with substantive work experience. Students will apply to the Department's Graduate Admissions Committee through the normal University application process.

### Diploma Requirements

The Graduate Diploma requires:

- Completion of 2.0 credits (four 0.5 credit courses):

ENVS*6503	[0.50]	Biogeochemistry of Wetlands
ENVS*6504	[0.50]	Classification and Assessment of Aquatic Systems
ENVS*6505	[0.50]	Soil Survey and Interpretation
ENVS*6506	[0.50]	Forest Ecosystem Patterns and Processes

### Collaborative Programs

#### Toxicology MSc/PhD

The School of Environmental Sciences participates in the MSc/PhD program in toxicology. The faculty members' research and teaching expertise includes aspects of toxicology; they may serve as advisors for MSc and PhD students.

Please consult the Toxicology listing for a detailed description of the MSc/PhD collaborative program and faculty associated with this program.

#### International Development Studies MSc

The School of Environmental Sciences participates in the MSc program in International Development Studies.

Please consult the International Development Studies listing for a detailed description of this program.

### Courses

<b>ENVS*6000 Physical Environment of Crops and Forests F [0.50]</b>
Recent literature on temperature, humidity, radiation, wind, gases and particles in crop and forest environments; evapotranspiration and photosynthesis of plant communities; modification of microclimates; applied micrometeorology. (Offered in even-numbered years).
<b>ENVS*6040 Molecular Basis of Plant-Microbe Interactions F [0.50]</b>
A lecture and seminar course on recent advances in the study of plant-microbe interactions. Topics included are the biochemical, physiological and genetic aspects of plant defenses and the interaction of plants with pathogenic and mutualistic bacteria, fungi and viruses. Offered in conjunction with PBIO*4000. Extra work is required of graduate students. <i>Restriction(s):</i> Credit may be obtained for only one of ENVS*6040 or PBIO*4000
<b>ENVS*6050 Micrometeorology W [0.50]</b>
Exchanges of mass, momentum and energy between the surface and the atmosphere will be studied in the context of larger-scale meteorology. Diffusion and turbulence in and above plant canopies will be examined from theoretical and practical perspectives. Topics include time-series analysis, micrometeorological measurement theory, and basic principles of atmospheric science. (Offered in even-numbered years).
<b>ENVS*6060 Meteorological Instrumentation W [0.50]</b>
Theoretical and practical aspects of electronic circuits, sensors, and equipment used in meteorological research. <i>Prerequisite(s):</i> ENVS*4120 or equivalent
<b>ENVS*6190 Environmental Microbial Technology U [0.50]</b>
Current topics in selected areas of environmental microbial technology. An emphasis will be placed on the physiology and genetics of microorganisms useful in environmental biotechnology. The course involves extensive use of current journal articles. <i>Restriction(s):</i> Undergraduate degree in microbiology or related discipline.
<b>ENVS*6241 Special Topics in Atmospheric Science F,U [0.25]</b>
The content is determined by the interests of the students and the availability of instructors. Topics may include aspects of statistics for climatology, animal biometeorology, air pollution meteorology, and hydrometeorology.



<b>ENVS*6242 Special Topics in Atmospheric Science F,U [0.50]</b>
See ENVS*6241
<b>ENVS*6250 Soil Genesis and Classification F [0.50]</b>
A discussion of world soil regions for students not specializing in soil genesis.
<b>ENVS*6280 Soil Physics W [0.50]</b>
The soil as a physical system with special regard to soil water movement and the diffusion and dispersion of chemical substances. Numerical techniques and computer solutions will be developed.
<b>ENVS*6340 Colloquium in Insect Systematics W [0.25]</b>
Weekly discussions and seminars dealing with current topics in systematic entomology. (Offered in odd-numbered years according to demand)
<b>ENVS*6350 Soil Organic Matter and Biochemistry F [0.50]</b>
(1) Soil organic matter characterization, (2) dynamics of soil organic matter, (0.5) nutrient cycling. (Offered in odd-numbered years).
<b>ENVS*6360 Soil and Water Chemistry F [0.50]</b>
Thermodynamics of soil solutions; solution-solid phase equilibria; reaction kinetics; computer modelling of solute-mineral interactions.
<b>ENVS*6380 Advanced Soil Chemistry W [0.50]</b>
The mathematical development of solute speciation models for aqueous solutions, surface complexation models for inorganic soil constituents and discrete and continuous functional group models for humic materials.
<b>ENVS*6400 Soil Nitrogen Fertility and Crop Production W [0.50]</b>
Emphasis will be placed on soil N transformations and processes, and N sources for crops; field experimentation methods; environmental issues.
<b>ENVS*6440 Field Sampling Strategies and Geostatistics W [0.50]</b>
Concepts and practical aspects of collecting, synthesizing and interpreting data from spatially and temporally variable and/or correlated fields. Hands-on experience in describing spatial structure of large data sets (supplied by student or instructor) using available software. (Offered in even-numbered years).
<b>ENVS*6451 Special Topics in Environmental Biology F,W,S [0.25]</b>
This course provides graduate students, either individually or in groups, with the opportunity to pursue topics in the major areas of departmental specialization such as plant protection, entomology, and environmental management. This course may be offered in any of lecture, reading/seminar, or individual project formats.
<b>ENVS*6452 Special Topics in Environmental Biology F,W,S [0.50]</b>
See ENVS*6451
<b>ENVS*6500 Environmental Sciences Research Project U [1.00]</b>
A concise, critical review of an area of study related to the field chosen by the student including analyses and interpretation of relevant data. The project will be written in the form of a scientific paper and presented to the department as a seminar.
<i>Restriction(s):</i> Available only to students registered in the Environmental Sciences: MES program.
<b>ENVS*6501 Advanced Topics in Environmental Science F [0.50]</b>
Using a case-study approach with material drawn from current and historical issues, students will develop an advanced understanding of current issues in the environmental sciences, including the underlying science basis, how the issues were managed, and the effectiveness of associated policies.
<b>ENVS*6502 Seminar in Environmental Sciences W [0.50]</b>
This course will provide an interactive and critical forum for students to participate in an advanced discussion and debate on current environmental issues, and to learn about the practical skill set(s) required by various employment sectors in solving these issues.
<b>ENVS*6503 Biogeochemistry of Wetlands S [0.50]</b>
A two-week course covering concepts and techniques related to the geology and geomorphology of the southern Ontario landscape. Focus will be given to the characterization and interpretation of geology and Earth materials and their influence on soil and water processes at the landscape level.
<b>ENVS*6504 Classification and Assessment of Aquatic Systems S [0.50]</b>
A two-week course covering concepts and techniques related to the physiographical, hydrological, and biological characterization of freshwater aquatic systems. The course will involve periodic excursions to regional water bodies in southern Ontario for the purpose of demonstrating sampling techniques and conducting biological assessments.

<b>ENVS*6505 Soil Survey and Interpretation S [0.50]</b>
A two-week course covering concepts and techniques related to the characterization of soil in the landscape. Focus will be given to soils encountered in southern Ontario, and involves a multi-day excursion to examine the distribution of soils in this region.
<b>ENVS*6506 Forest Ecosystem Patterns and Processes S [0.50]</b>
A two-week course covering concepts and techniques related to the ecological characterization of forests. Focus will be on southern and mid-central Ontario forests and will involve periodic excursions to various locations for the purpose of demonstrating theoretical principles, sampling techniques, in-field measurements, and collecting samples for in-lab assessment and metric determination.
<b>ENVS*6520 Pollination Biology F [0.50]</b>
Pollination biology is discussed from both entomological and botanical viewpoints, stressing fundamental and applied aspects. (Offered in the Fall semester or by arrangement with the professor).
<b>ENVS*6540 Integrated Pest Management - Insects W [0.50]</b>
Concepts associated with integrated pest management of insect pests of various plant hosts will be introduced to students in an interactive lecture and laboratory format. Experiential learning and skill development, associated with economic entomology, will also be emphasized. (Offered in even-numbered years.)
<i>Restriction(s):</i> Credit may be obtained for only one of ENVS*6540 and ENVS*4100
<b>ENVS*6550 Bioactivity and Metabolism of Pesticides W [0.50]</b>
The basis of pesticide bioactivity will be examined, with emphasis on mode of action, structure-activity relationships and analytical methods. Students will participate in seminars and prepare a research paper and/or conduct a laboratory research project in consultation with the instructor(s). Students in this course are expected to attend the lectures for ENVS*4240.
<b>ENVS*6560 Forest Ecosystem Dynamics F [0.50]</b>
An exploration of energy flow and distribution in forest ecosystems. Both components will be examined in the context of biomass and productivity, perturbations and resilience. Some aspects of modelling will be covered.
<b>ENVS*6581 Special Topics in Soil Science U [0.25]</b>
Students will discuss issues that are relevant to the current research of faculty or visiting faculty. Generally presented as a combination of lectures, student seminars and written projects.
<b>ENVS*6582 Special Topics in Soil Science U [0.50]</b>
See ENVS*6581
<b>ENVS*6700 Glacial Sedimentary Environments U [0.50]</b>
Students will learn about the processes and deposits of glacial environments as well as the use of sedimentary records to reconstruct past glacial environments. Case studies from modern to ancient glacial sedimentary environments will be used. Field trip included. (Offered only as needed)
<b>ENVS*6710 Advanced Sedimentology U [0.50]</b>
Topics covered through case studies of sedimentary deposits and environments include facies analysis, large scale controls, and novel techniques in sedimentology. Topics may also include specific sedimentary environments or specific sedimentary deposits such as turbidites, cross-bedded strata or seismites depending on student interest. (Offered only as needed)
<b>ENVS*6730 Special Topics in Environmental Earth Science U [0.50]</b>
A study of principles and analyses of local environmental problems involving the application of geological and soil information of land use applications and possible hazardous conditions.
<b>ENVS*6881 Special Topics in Land Resources Management U [0.25]</b>
Students will discuss issues that are relevant to the current research of faculty or visiting faculty. Generally presented as a combination of lectures, student seminars and written projects.
<b>ENVS*6882 Special Topics in Land Resources Management U [0.50]</b>
See ENVS*6881
<b>ENVS*6900 Research Seminar in Environmental Sciences F-W [0.50]</b>
This course provides information and training in scientific presentations. Students will prepare a written essay based on their research and make an oral presentation of the proposed studies. Students are expected to take this course in their second or third semester of study.