

# 2017-2018 Graduate Calendar

The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2017-2018 academic years, including the Summer Semester 2017, Fall Semester 2017 and the Winter Semester 2018.

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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The logo for the University of Guelph, featuring the text "UNIVERSITY of GUELPH" in a stylized font.The tagline "CHANGING LIVES IMPROVING LIFE" in a bold, sans-serif font, set against a yellow background.

## **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 <https://www.uoguelph.ca/registrar/>

### **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.

The PhD program has three fields of specialization: 1) earth and atmospheric sciences; 2) ecosystem science and biodiversity; and 3) plant and environmental health.

- Earth and Atmospheric Sciences – Research areas include: soil biology and soil physics, sedimentology, geobiology, soil chemistry, geochemistry, micrometeorology 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

### Administrative Staff

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BA McMaster, MSc UBC, PhD McMaster - Associate Professor

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#### Michael A. Dixon

BSc, MSc Mount Allison, PhD Edinburgh - Professor

#### Kari Dunfield

BSc Calgary, MSc, PhD Saskatchewan - Associate Professor

#### Brandon Gilroyed

BSc Alberta, PhD Calgary - Assistant Professor

#### Susan Glasauer

BSc, MSc California, PhD Munich - Associate Professor

#### Paul H. Goodwin

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

#### Ernesto Guzman

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

#### Marc Habash

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#### Beverly Hale

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

#### Rebecca Hallett

BSc Toronto, MPM, PhD Simon Fraser - Professor

#### Richard J. Heck

BSA, MSc, PhD Saskatchewan - Associate Professor

#### Thomas Hsiang

BSc, MSc British Columbia, PhD Washington - Professor and Graduate Studies Coordinator

#### Shelley L. Hunt

BSc, PhD Guelph - Associate Professor and Director of the Arboretum

#### 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

#### Ivan O'Halloran

BSc, MSc Guelph, PhD Saskatchewan - Associate Professor

#### Gard W. Otis

BS Duke, PhD Kansas - Professor

#### Gary W. Parkin

BSc, MSc Western, PhD Guelph - Associate Professor

#### Nigel Raine

BA, PhD Oxford - Professor

#### Neil Rooney

BSc, MSc Western Ontario - Assistant Professor

#### Jonathan M. Schmidt

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

#### 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

#### Jon S. Warland

BSc Cornell, MSc UBC, PhD Guelph - Associate Professor and Acting Director, School of Environmental Sciences

#### Youbin Zheng

BSc, MSc Southwest Agricultural, MPhil, PhD Newcastle - Associate Professor

### Associated Graduate Faculty

#### Pedro Antunes

BSc Evora, PhD Guelph - Associate Professor, Algoma University

#### Chris Cutler

BSc Memorial, MPM Simon Fraser, PhD Guelph - Associate Professor, Department of Agriculture, Dalhousie University

#### Deena Errampalli

MSc Banaras, MBA, Osmania, PhD Oklahoma - Research Scientist, AAFC, Vineland

#### Les Evans

BSc Southampton, PhD Wales - University Professor Emeritus, Environmental Sciences, University of Guelph

#### Terry Gillespie

BSc British Columbia, MA Toronto, PhD Guelph - Professor Emeritus, University of Guelph

#### Robert Gordon

BSc Guelph, MSc McGill, PhD Guelph - Vice President, Research, Wilfrid Laurier University

#### Pieter Groenevelt

BSc, MSc, PhD Wageningen - Professor Emeritus, Environmental Sciences, University of Guelph

#### Christopher Hall

BSc, MSc Guelph, PhD Alberta - Retired Faculty, Environmental Sciences, University of Guelph

#### Peter Kevan

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#### James Longstaffe

BSc Western, MSc Dalhousie, PhD Toronto - Assistant Professor, Environmental Sciences, University of Guelph

#### Merrin Macrae

BES, MSc York, PhD Wilfrid Laurier - Associate Professor, Geography and Environmental Management, University of Waterloo

#### Gary Parkin

Retired Faculty, Environmental Sciences, University of Guelph - BSc, MSc Western, PhD Guelph

#### Keith Solomon

BSc, MSc Rhodes, PhD Illinois - Professor Emeritus, Environmental Sciences, University of Guelph

#### Naresh Thevathasan

BSc Eastern, PhD Guelph, DSc Honorary Kwame - Manager, Agroforestry Research and Development, Environmental Sciences, University of Guelph

**Andrew VanderZaag**

BSc Guelph, PhD Dalhousie - Research Scientist, Agriculture and Agri-Food Canada

**Susan Weir**

BSc, PhD Guelph - Senior Microbiologist, Ontario Ministry of the Environment

**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 0.50 credit course (Research Seminar in Environmental Sciences).
- 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**

The School's admission standard for the MES 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 semester of study to continue in the program. Provisional students will be funded at the same level as regular students

**MES Degree Requirements****Course Work and Major Research Project (MRP)**

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 a written report and a seminar presented to the department.

**Course Work**

Candidates must complete a minimum of 4.0 credits

- ENVS\*6501 F [0.5] Advanced Topics in Environmental Science

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- 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. A maximum of 1.0 credits may be taken from senior undergraduate courses, with permission of the Graduate Coordinator.

**PhD Program**

The PhD is offered in the following fields: 1) earth and atmospheric sciences; 2) ecosystems science and biodiversity; and 3) plant and environmental health. 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.

**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 0.50 credit course (Research Seminar in Environmental Sciences).
- 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.

**Collaborative Specializations****International Development Studies**

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

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

**Toxicology**

The School of Environmental Sciences participates in the MSc/PhD collaborative specialization 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 specialization.

## 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. <i>Offering(s):</i> Offered in even-numbered years. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Offering(s):</i> Offered in even-numbered years. <i>Department(s):</i> School of Environmental Sciences
<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*4210 or equivalent <i>Department(s):</i> School of Environmental Sciences
<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. <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6242 Special Topics in Atmospheric Science F,W,S [0.50]</b>
Students will explore topics within atmospheric science such as climatology, animal biometeorology, air pollution meteorology, and hydrometeorology. Normally, an independent course of study will be developed with a faculty advisor and one or more students in the semester prior to enrollment. Occasionally, the course will be offered as a lecture/seminar in a particular area, to be advertised in the semester prior to offering. Typically, students will produce a major paper or scientific report. <i>Restriction(s):</i> Instructor consent required. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6340 Colloquium in Insect Systematics W [0.25]</b>
Weekly discussions and seminars dealing with current topics in systematic entomology. <i>Offering(s):</i> Offered in odd-numbered years. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Offering(s):</i> Offered in odd-numbered years. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Offering(s):</i> Offered in even-numbered years. <i>Department(s):</i> School of Environmental Sciences

<b>ENVS*6452 Special Topics in Ecosystem Science and Biodiversity F,W,S [0.50]</b>
Students will explore topics within ecosystem science such as terrestrial ecology, forest science, aquatic systems and environmental biology. Normally, an independent course of study will be developed with a faculty advisor and one or more students in the semester prior to enrollment. Occasionally, the course will be offered as a lecture/seminar in a particular area, to be advertised in the semester prior to offering. Typically, students will produce a major paper or scientific report. <i>Restriction(s):</i> Instructor consent required. <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6460 Environmental Remediation W [0.50]</b>
This course will discuss environmental remediation topics including, but not limited to, using plants, microorganisms and substrates (e.g., soil and engineered materials) to improve air, water and soil quality. For example, this course will explore the current sciences and technologies of living walls to improve indoor air quality, green roofs to manage storm water and air pollutants, and constructed wetlands to treat wastewater. Environmental remediation is, by nature, multidisciplinary, involving chemistry, physics, biology, engineering, landscape design, etc. <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6470 The Science and Management of Multiple Stressors in the Great Lakes F [0.50]</b>
In this two-week lecture-field course, students will learn about historical and current environmental issues affecting the Great Lakes basin from the perspective of multiple stressors and their cumulative impacts. The importance of linking science and policy, and the role important of governments, are emphasized. <i>Restriction(s):</i> Instructor consent required. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6501 Integrating Science and Policy in Environmental Science F [0.50]</b>
A case-study approach, based on current and historical issues, and involving presentations from faculty, professionals and students, will be used to develop an advanced understanding of current issues in the environmental sciences, including examination of the underlying science and management of the issues, and the effectiveness of associated policies. <i>Restriction(s):</i> Preference will be given to students in the MES.ENVS:L. <i>Department(s):</i> School of Environmental Sciences
<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. <i>Restriction(s):</i> Instructor consent required. Preference will be given to students in the MES program. <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6503 Biogeochemistry of Wetlands S [0.50]</b>
This course is focused on the role of wetlands in maintaining healthy ecosystems and in controlling contaminant fluxes to water. Lectures complement field and laboratory assessments of wetlands to understand element biogeochemical cycles in these transitional environments. The course includes field trips to Ontario wetlands. <i>Restriction(s):</i> Preference will be given to students in MES.ENVS:L, MSc.ENVS and PhD.ENVS <i>Department(s):</i> School of Environmental Sciences
<b>ENVS*6505 Soil Survey and Interpretation S [0.50]</b>
Students will learn concepts, techniques and analysis related to the characterization of soil in the landscape. Focus will be given to soils encountered in southern Ontario. Course involves multiple field excursions to examine the distribution of soils in this region. <i>Restriction(s):</i> Preference will be given to students in MES.ENVS:L, MSc.ENVS, PhD.ENVS <i>Department(s):</i> School of Environmental Sciences



**ENVS\*6506 Forest Ecosystem Patterns and Processes S [0.50]**

Students will learn concepts, techniques and analysis 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.

*Restriction(s):* Preference will be given to students in MES.ENVS:L, MSc.ENVS, PhD.ENVS

*Department(s):* School of Environmental Sciences

**ENVS\*6520 Pollinator Biology F [0.50]**

The biology of pollinators will be discussed in lectures and seminars stressing fundamental and applied aspects. The honey bee will be used as the model system.

*Offering(s):* Offered in odd-numbered years.

*Department(s):* School of Environmental Sciences

**ENVS\*6530 Pollinator Conservation W [0.50]**

In this course students will explore the ecology of pollination with an emphasis on the factors affecting declines in pollinating insects as well as potential mitigation strategies to ensure long-term stability of food production and maintenance of biodiverse wild plant communities. Offered in conjunction with ENVS\*4070. Extra work is required of graduate students.

*Restriction(s):* Credit may be obtained for only one of ENVS\*6530 or ENVS\*4070.

*Department(s):* School of Environmental Sciences

**ENVS\*6540 Integrated Pest Management - Insects W [0.50]**

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.

*Offering(s):* Offered annually

*Restriction(s):* Credit may be obtained for only one of ENVS\*6540 and ENVS\*4100

*Department(s):* School of Environmental Sciences

**ENVS\*6550 Bioactivity and Metabolism of Insecticides W [0.50]**

The basis of insecticide bioactivity will be examined, with emphasis on mode of action, structure-activity relationships and analytical methods. Students will choose a specific insecticide or class of insecticides as their primary topic of study for the semester. Students will participate in seminars, prepare a conference poster and complete a research paper.

*Offering(s):* Offered in even-numbered years.

*Department(s):* School of Environmental Sciences

**ENVS\*6560 Forest Ecosystem Dynamics F [0.50]**

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.

*Offering(s):* Offered in odd-numbered years.

*Department(s):* School of Environmental Sciences

**ENVS\*6582 Special Topics in Soil Science F,W,S [0.50]**

Students will explore topics within soil science such as soil physics, pedology, soil chemistry and microbiology. Normally, an independent course of study will be developed with a faculty advisor and one or more students in the semester prior to enrollment. Occasionally, the course will be offered as a lecture/seminar in a particular area, to be advertised in the semester prior to offering. Typically, students will produce a major paper or scientific report.

*Restriction(s):* Instructor consent required.

*Department(s):* School of Environmental Sciences

**ENVS\*6700 Glacial Sedimentary Environments U [0.50]**

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.

*Offering(s):* Offered only as needed

*Department(s):* School of Environmental Sciences

**ENVS\*6710 Advanced Sedimentology U [0.50]**

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)

*Offering(s):* Offered only as needed

*Department(s):* School of Environmental Sciences

**ENVS\*6720 Geology of Groundwater Systems W [0.50]**

This course will examine the geological characteristics and processes that influence groundwater flow systems and contaminant transport and fate in different geological settings. The course will include seminar discussions of readings, guest speakers from industry and government agencies as well as hands-on exercises in class.

*Offering(s):* Offered in alternate years

*Department(s):* School of Environmental Sciences

**ENVS\*6730 Special Topics in Environmental Earth Science F,W,S [0.50]**

Students will explore topics within environmental earth science such as glacial geology, environmental geophysics and hydrogeology. Normally, an independent course of study will be developed with a faculty advisor and one or more students in the semester prior to enrollment. Occasionally, the course will be offered as a lecture/seminar in a particular area, to be advertised in the semester prior to offering. Typically, students will produce a major paper or scientific report.

*Restriction(s):* Instructor consent required.

*Department(s):* School of Environmental Sciences

**ENVS\*6740 Environmental Organic Chemistry W [0.50]**

This course explores the chemical processes that influence organic compounds in the environment. Topics discussed include: the transformation of anthropogenic organic contaminants, the form and function of natural organic matter, and analytical methods including compound specific stable isotope analysis and environmental nuclear magnetic resonance. Offered in conjunction with ENVS\*4370. Extra work is required of graduate students.

*Restriction(s):* Credit may be obtained for only one of ENVS\*6740 or ENVS\*4370.

Preference will be given to students in the MES.ENVS, MSc.ENVS and PhD.ENVS programs.

*Department(s):* School of Environmental Sciences

**ENVS\*6882 Special Topics in Plant and Environmental Health F,W,S [0.50]**

Students will explore topics within plant and environmental health such as integrated pest management, apiculture and environmental microbiology. Normally, an independent course of study will be developed with a faculty advisor and one or more students in the semester prior to enrollment. Occasionally, the course will be offered as a lecture/seminar in a particular area, to be advertised in the semester prior to offering. Typically, students will produce a major paper or scientific report.

*Restriction(s):* Instructor consent required.

*Department(s):* School of Environmental Sciences

**ENVS\*6900 Research Seminar in Environmental Sciences F-W [0.50]**

This course provides information and training in scientific presentations for thesis-based Environmental Sciences (ENVS) programs. Students will prepare a written research proposal and make an oral presentation of their proposed studies. Students are expected to complete this course in their second or third semester of study.

*Restriction(s):* Offered only to MSc.ENVS and PHD.ENVS students

*Department(s):* School of Environmental Sciences