The School of Environmental Sciences offers a program of study leading to MSc, MES, and PhD 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

- Earth and Atmospheric Sciences – Research areas include: soil biology and soil physics, environmental geology, geobiology, soil chemistry, geochemistry, micrometeorology and ecohydrology, soil health 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 entomology
- 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**

**Interim Director, School of Environmental Sciences**
Paul Sibley (106 Alexander Hall, Ext. 52707)
psibley@uoguelph.ca

**Associate Director, Graduate Studies, School of Environmental Sciences (MES/PhD)**
Asim Biswas (135 Alexander Hall, Ext. 54249)
abiswas@uoguelph.ca

**Associate Director, Graduate Studies, School of Environmental Sciences (MSc)**
Youbin Zhen (2220 Bovey Bldg., Ext. 52741) MSc
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**Graduate Program Assistant**
Jennifer LaPorte (275 Alexander Hall, Ext. 53937)

ses.gradsec@uoguelph.ca

This list may include Regular Graduate Faculty, Associated Graduate Faculty and/or Graduate Faculty from other universities.

**Genevieve Ali**
B.Sc., M.Sc., PhD Université du Montréal - Associate Professor Graduate Faculty

**Madhur Anand**
B.Sc., PhD Western Ontario - Professor Graduate Faculty

**Emmanuelle Arnaud**
BA McMaster, M.Sc. British Columbia, PhD McMaster - Associate Professor Graduate Faculty

**Asim Biswas**
B.Sc. Bidhan Chandra, M.Sc. Bangalore, PhD Saskatchewan - Associate Professor Graduate Faculty

**Rosemarjie Buitenhuis**
B.Sc., M.Sc. Leiden, PhD Laval - Research Scientist, Vineland Research and Innovation Centre

**Michael A. Dixon**
B.Sc., M.Sc. Mount Allison, PhD Edinburgh - Professor Graduate Faculty

**Kari Dunfield**
B.Sc. Calgary, M.Sc., PhD Saskatchewan - Professor Graduate Faculty

**Deena Errampalli**
M.Sc. Banaras, MBA, Osmania, PhD Oklahoma - Research Scientist, AAFC, Vineland

**Les J. Evans**
B.Sc. Southampton, PhD Wales - University Professor Emeritus, Environmental Sciences, University of Guelph

**Tara Gariepy**
B.Sc. Concordia, M.Sc. Simon Fraser, PhD Saskatchewan - Research Scientist, Agriculture and Agri-Food Canada

**Adam Gillespie**
B.Sc., M.Sc., PhD Guelph - Assistant Professor Associated Graduate Faculty

**Brandon Gilroyed**
B.Sc. Calgary, M.Sc. - Associate Professor Graduate Faculty

**Susan Glasauer**
B.Sc., M.Sc. California, PhD Munich - Associate Professor Graduate Faculty

**Paul H. Goodwin**
BS Villanova, M.Sc. Minnesota, PhD UC Davis - Professor Graduate Faculty

**Jackie Goodfial**
B.Sc. Toronto-Scarborough, M.Sc., PhD McGill - Assistant Professor Associated Graduate Faculty

**Robert Gordon**
B.Sc., M.Sc. McGill, PhD Guelph - President, University of Windsor
Associated Graduate Faculty

**Thomas Graham**
B.Sc., M.Sc., PhD Wageningen - Assistant Professor, Environmental Sciences, University of Guelph
Graduate Faculty

**Ernesto Guzman**
DVM Mexico, M.Sc., PhD UC Davis - Professor
Graduate Faculty

**Marc Habash**
B.Sc. Toronto, M.Sc. Western, PhD Guelph - Associate Professor, Environmental Sciences
Graduate Faculty

**Beverley Hale**
B.Sc., M.Sc. Toronto, PhD Guelph - Professor and Associate Vice President Research (Agri-Food Partnership)
Graduate Faculty

**Rebecca Hallett**
B.Sc. Toronto, MPM, PhD Simon Fraser - Professor and Associate Dean (Research & Graduate Studies), Ontario Agricultural College
Graduate Faculty

**Richard J. Heck**
BSA, M.Sc., PhD Saskatchewan - Professor
Graduate Faculty

**Thomas Hsiang**
B.Sc., M.Sc. British Columbia, PhD Washington - Professor
Graduate Faculty

**Shelley L. Hunt**
B.Sc., PhD Guelph - Retired Professor, Environmental Sciences, University of Guelph
Associated Graduate Faculty

**Peter G. Kevan**
B.Sc. McGill, PhD Alberta - University Professor Emeritus
Associated Graduate Faculty

**Lauren Knopper**
Principal, Environmental Services, Stantec Consulting Ltd.
Associated Graduate Faculty

**Scott Krayenhoff**
B.Sc., M.Sc. Lethbridge, PhD British Columbia - Assistant Professor
Graduate Faculty

**Roselyne Labbe**
B.Sc. Western Ontario, M.Sc. Laval, PhD Western Ontario - Research Scientist, Agriculture and Agri-Food Canada
Associated Graduate Faculty

**Simon Lachance**
B.Sc., M.Sc. Laval, PhD Guelph - College Professor, Ridgetown Campus
Associated Graduate Faculty

**John D. Lauzon**
B.Sc., M.Sc., PhD Guelph - Associate Professor
Graduate Faculty

**Hung Lee**

B.Sc. British Columbia, PhD McGill - Professor Emeritus
Associated Graduate Faculty

**James Longstaffe**
B.Sc. Western, M.Sc. Dalhousie, PhD Toronto - Assistant Professor
Graduate Faculty

**Steven A. Marshall**
B.Sc. Guelph, M.Sc. Carleton, PhD Guelph - University Professor Emeritus, Environmental Sciences, University of Guelph
Associated Graduate Faculty

**Nadia Mykytczuk**
B.Sc. Carleton, PhD Laurentian - Associate Professor, Laurentian University
Associated Graduate Faculty

**Joseph Northrup**
Associated Graduate Faculty

**Gard Otis**
B.Sc. Duke, PhD Kansas - Professor Emeritus, Environmental Sciences, University of Guelph
Associated Graduate Faculty

**Gary Parkin**
B.Sc., M.Sc. Western, PhD Guelph - Retired Faculty, Environmental Sciences, University of Guelph
Associated Graduate Faculty

**Jesse Popp**
B.Sc., M.Sc., PhD Laurentian - Associate Professor
Graduate Faculty

**Ryan Prosser**
BEd Wollongong, B.Sc., PhD Guelph - Associate Professor
Graduate Faculty

**Nigel Raine**
BA, PhD Oxford - Professor
Graduate Faculty

**Justin Renkema**
Research Scientist, Agriculture and Agri-Food Canada - B.Sc. Redeemer, M.Sc. Guelph, Ph.D. Dalhousie
Associated Graduate Faculty

**Neil Rooney**
B.Sc., M.Sc. Western Ontario - Assistant Professor
Graduate Faculty

**Jonathan M. Schmidt**
B.Sc., PhD Toronto - Associate Professor and Associate Dean (Academic), Ontario Agricultural College
Graduate Faculty

**Cynthia D. Scott-Dupree**
B.Sc. Brandon, MPM, PhD Simon Fraser - Professor
Graduate Faculty

**Paul K. Sibley**
B.Sc., M.Sc. Guelph, PhD Waterloo - Professor and Interim Director
Graduate Faculty
the University and requires a four-year, honours science degree with a

The School's admission standard for the MES program is the same as

**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 (73%) with no individual grade lower than 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.

**Program 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 two semesters of study to continue in the program.

**MES Program Requirements**

**Course Work and Major Research Project (MRP)**

Candidates must complete a minimum of 4.0 credits:

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>ENVS*6500</td>
<td>Environmental Sciences Research Project</td>
<td>1.00</td>
</tr>
<tr>
<td>ENVS*6501</td>
<td>Integrating Science and Policy in Environmental Science</td>
<td>0.50</td>
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</tbody>
</table>
ENVS*6501 Integrating Science and Policy in Environmental Science 0.50
ENVS*6502 Seminar in Environmental Science 0.50
Three additional credits from Environmental Sciences courses 3.00

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

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<th>Credits</th>
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<tbody>
<tr>
<td>ENVS*6501</td>
<td>Integrating Science and Policy in Environmental Science</td>
<td>0.50</td>
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<tr>
<td>ENVS*6502</td>
<td>Seminar in Environmental Science</td>
<td>0.50</td>
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</table>

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%) and no individual mark below 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.

Program 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.

One Health
The School of Environmental Sciences participates in the collaborative specialization in One Health. Master’s and Doctoral students wishing to undertake thesis research or their major research paper/project with an emphasis on one health are eligible to apply to register concurrently in Environmental Sciences and the collaborative specialization. Students should consult the One Health (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/one-health/) listing for more information.

Toxicology
The School of Environmental Sciences participates in the masters/doctoral 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 (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/toxicology/) listing for a detailed description of the masters/doctoral collaborative specialization.
Courses

ENVS*6000  Physical Environment of Crops and Forests  Fall Only  [0.50]
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.
Offering(s): Offered in even-numbered years.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6040  Molecular Basis of Plant-Microbe Interactions  Fall Only  [0.50]
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.
Restriction(s): Credit may be obtained for only one of ENVS*6040 or PBIO*4000.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6050  Micrometeorology  Winter Only  [0.50]
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.
Offering(s): Offered in even-numbered years.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6060  Meteorological Instrumentation  Winter Only  [0.50]
Theoretical and practical aspects of electronic circuits, sensors, and equipment used in meteorological research.
Prerequisite(s): ENVS*4210
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6190  Environmental Microbial Technology  Unspecified  [0.50]
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. An undergraduate degree in microbiology or related discipline is recommended prior to registering in this course.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6242  Topics in Atmospheric Science  Summer, Fall, and Winter  [0.50]
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.
Restriction(s): Instructor consent required.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6280  Soil Physics  Winter Only  [0.50]
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.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6300  Quantitative Pedology  Fall Only  [0.50]
Pedology considers the morphology, survey, geography, characterization and analysis, development, classification, and interpretation of soil. This course focuses on the quantification of pedology, employing modern digital instrumentation, computational capacity and analytical strategies. Students explore how such multi-scale, spatial-temporal information is used in critical zone modeling. Students should have at least an introductory soil, ecology or physical geography course. Students with only an introductory level soil course are encouraged to audit ENVS*4390.
Restriction(s): Cannot take in credit received for ENVS*6250.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6340  Colloquium in Insect Systematics  Winter Only  [0.25]
Weekly discussions and seminars dealing with current topics in systematic entomology.
Offering(s): Offered in odd-numbered years.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6350  Soil Organic Matter and Biochemistry  Fall Only  [0.50]
(1) Soil organic matter characterization, (2) dynamics of soil organic matter, (0.5) nutrient cycling.
Offering(s): Offered in odd-numbered years.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6360  Soil and Water Chemistry  Fall Only  [0.50]
Thermodynamics of soil solutions; solution-solid phase equilibria; reaction kinetics; computer modelling of solute-mineral interactions.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6400  Soil Nitrogen Fertility and Crop Production  Winter Only  [0.50]
Emphasis will be placed on soil N transformations and processes, and N sources for crops; field experimentation methods; environmental issues.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6440  Field Sampling Strategies and Geostatistics  Winter Only  [0.50]
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.
Offering(s): Offered in even-numbered years.
Department(s): School of Environmental Sciences
Location(s): Guelph
ENVS*6450 Multivariate Environmental Data Analysis Winter
Only [0.50]
This course will examine the application of statistical techniques to
analyzing multivariate environmental data. Methods will include
Ordination (e.g., Principal Components Analysis, NDMS), Multivariate
Regression (e.g., Partial Least Squares Regression), and Structural
Equation Modelling. Emphasis will be placed on peer and collaborative
learning through discussion, and comparative application of analyses
to multivariate environmental data. Students should have at least one
undergraduate course in statistics.
Restriction(s): Instructor consent required.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6452 Special Topics in Ecosystem Science and
Biodiversity Summer, Fall, and Winter [0.50]
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.
Restriction(s): Instructor consent required.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6450 Environmental Remediation Winter Only [0.50]
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.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6470 The Science and Management of Multiple Stressors in the
Great Lakes Fall Only [0.50]
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.
Restriction(s): Instructor consent required.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6501 Integrating Science and Policy in Environmental
Science Fall Only [0.50]
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.
Restriction(s): Restricted to students in the MES program.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6502 Seminar in Environmental Science Winter Only [0.50]
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.
Restriction(s): Restricted to students in the MES program.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6503 Biogeochemistry of Wetlands Landscapes Landscapes Fall
Only [0.50]
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.
Prerequisite(s): BIOL*1020 BIOL*1070 CHEM*1040 CHEM*1070 and
PHYS*1070 or PHYS*1080
Restriction(s): Restricted to Environmental Sciences students.
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6505 Soil Survey and Interpretation Summer Only [0.50]
Students will learn concepts, techniques and analysis related to
the characterization of soil in the landscape. Focus will be given to
soils found in southern Ontario. Course involves multiple
field excursions to examine the distribution of soils in this region.
Restriction(s): Restricted to students in MES.ENVS.L, MSc.ENVS,
PhD.ENVS
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6506 Forest Ecosystem Patterns and Processes Summer
Only [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): Restricted to students in MES.ENVS.L, MSc.ENVS,
PhD.ENVS
Department(s): School of Environmental Sciences
Location(s): Guelph

ENVS*6507 Pollinator Biology Fall Only [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
Location(s): Guelph
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Offerings</th>
<th>Description</th>
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<tbody>
<tr>
<td>ENVS*6530</td>
<td>Pollinator Conservation</td>
<td>Winter Only [0.50]</td>
<td>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.</td>
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<td><strong>Restriction(s):</strong> Credit may be obtained for only one of ENVS<em>6530 or ENVS</em>4070.</td>
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<td><strong>Department(s):</strong> School of Environmental Sciences</td>
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<td>ENVS*6540</td>
<td>Integrated Pest Management: Insects</td>
<td>Winter Only [0.50]</td>
<td>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 conjunction with ENVS*4100. Extra work is required of graduate students.</td>
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<td><strong>Offering(s):</strong> Offered annually</td>
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<tr>
<td>ENVS*6550</td>
<td>Bioactivity and Metabolism of Insecticides</td>
<td>Winter Only [0.50]</td>
<td>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.</td>
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<td><strong>Offering(s):</strong> Offered in even-numbered years.</td>
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<tr>
<td>ENVS*6560</td>
<td>Forest Ecosystem Dynamics</td>
<td>Fall Only [0.50]</td>
<td>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.</td>
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<td><strong>Offering(s):</strong> Offered in odd-numbered years.</td>
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<tr>
<td>ENVS*6582</td>
<td>Special Topics in Soil Science</td>
<td>Summer, Fall, and Winter [0.50]</td>
<td>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.</td>
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<td><strong>Restriction(s):</strong> Instructor consent required.</td>
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<tr>
<td>ENVS*6720</td>
<td>Geology of Groundwater Systems</td>
<td>Winter Only [0.50]</td>
<td>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.</td>
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<td><strong>Offering(s):</strong> Offered in alternate years</td>
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<tr>
<td>ENVS*6730</td>
<td>Special Topics in Environmental Earth Science</td>
<td>Summer, Fall, and Winter [0.50]</td>
<td>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.</td>
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<td><strong>Restriction(s):</strong> Instructor consent required.</td>
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<td>ENVS*6740</td>
<td>Environmental Organic Chemistry</td>
<td>Winter Only [0.50]</td>
<td>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.</td>
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<td><strong>Restriction(s):</strong> Credit may be obtained for only one of ENVS<em>6740 or ENVS</em>4370. Restricted to students in the MES.ENVS, MSc.ENVS and PhD.ENVS programs.</td>
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<tr>
<td>ENVS*6882</td>
<td>Special Topics in Plant and Environmental Health</td>
<td>Summer, Fall, and Winter [0.50]</td>
<td>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.</td>
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<td><strong>Restriction(s):</strong> Instructor consent required.</td>
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<td>ENVS*6900</td>
<td>Research Seminar in Environmental Sciences</td>
<td>Fall and Winter Reg Required [0.50]</td>
<td>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.</td>
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<td><strong>Restriction(s):</strong> Restricted to MSC.ENVS and PHD.ENVS students</td>
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