MASTER OF SCIENCE
BIOLOGY SPECIALIZATION
IN ENVIRONMENTAL SUSTAINABILITY

Summary
- Degree offered: Master of Science (MSc)
- Registration status options: Full-time; Part-time
- Language of instruction: English
- Primary program: MSc in Biology
- Collaborative specialization: Environmental Sustainability
- Program option (expected duration of the program):
  - with thesis (6 full-time terms; 24 consecutive months)
- Academic units: Faculty of Science (http://science.uottawa.ca/), Department of Biology (http://science.uottawa.ca/biology/), Ottawa-Carleton Institute of Biology (http://www.ocib.ca/), Institute of the Environment (https://www.uottawa.ca/environment/).

Program Description

Ottawa-Carleton Joint Program

Established in 1984, the Ottawa-Carleton Institute of Biology (OCIB) combines the research strengths of the University of Ottawa and Carleton University. The Institute offers graduate programs leading to the master’s (MSc) and doctoral (PhD) degrees in Biology.

Research facilities are shared between the two campuses. Students have access to the professors, courses and facilities at both universities.

The Institute is a participating unit in the collaborative programs in Bioinformatics (at the master’s level), in Chemical and Environmental Toxicology (at the master’s and doctoral levels), in Environmental Sustainability (at the master’s level) in Bioinformatics, and in Science, Society and Policy (at the master’s level).

Collaborative Program Description

The Institute of the Environment offers a master’s level collaborative program in Environmental Sustainability and an interdisciplinary Master of Science (MSc) in Environmental Sustainability. The master’s level collaborative program in Environmental Sustainability allows students enrolled in one of the participating master’s programs to specialize in environmental sustainability.

The guiding objective of the collaborative program is to provide graduate students with the knowledge and skills needed to identify and analyze the economic, legal, policy and scientific dimensions of environmental problems, and to employ an evidence-based approach to develop rational policy options for addressing those problems.

The degree awarded specifies the primary program and indicates “Specialization in Environmental Sustainability.”

Main Areas of Research
- Cell and molecular biology
- Ecology, behaviour and systematics
- Physiology and biochemistry

Other Programs Offered Within the Same Discipline or in a Related Area
- Master of Science Biology (MSc)
- Master of Science Biology Specialization in Chemical and Environmental Toxicology (MSc)
- Master of Science Biology Specialization in Bioinformatics (MSc)
- Master of Science Biology Specialization in Science, Society and Policy (MSc)
- Doctorate in Philosophy Biology (PhD)
- Doctorate in Philosophy Biology Specialization in Chemical and Environmental Toxicology (PhD)

Fees and Funding
- Program fees:
  - The estimated amount for university fees (https://www.uottawa.ca/university-fees/) associated with this program are available under the section Finance your studies (http://www.uottawa.ca/graduate-studies/programs-admission/finance-studies/).
  - International students enrolled in a French-language program of study may be eligible for a differential tuition fee exemption (https://www.uottawa.ca/university-fees/differential-tuition-fee-exemption/).
- To learn about possibilities for financing your graduate studies, consult the Awards and financial support (https://www.uottawa.ca/graduate-studies/students/awards/) section.

Notes
- Programs are governed by the general regulations (http://www.uottawa.ca/graduate-studies/students/general-regulations/) in effect for graduate studies and by the General Regulations of the Ottawa-Carleton Institute of Biology (OCIB).
- In accordance with the University of Ottawa regulation, students have the right to complete their assignments, examinations, research papers, and theses in French or in English.
- Research activities can be conducted either in English, French or both, depending on the language used by the professor and the members of his or her research group.

Program Contact Information

Graduate Studies Office, Faculty of Science (https://science.uottawa.ca/en/faculty-services/graduate-studies/)

30 Marie-Curie Street, Gendron Hall, Room 181
Ottawa, Ontario, Canada
K1N 6N5

Tel.: 613-562-5800 x3145
Email: gradsci@uOttawa.ca

Twitter | Faculty of Science (https://twitter.com/uOttawaScience/?lang=en)
Facebook | Faculty of Science (https://www.facebook.com/uOttawaScience/)
Twitter | Institute of the Environment (https://twitter.com/uoEnvironment/)
Facebook | Institute of the Environment (https://www.facebook.com/uOttawaIE/)

Admission Requirements

For the most accurate and up to date information on application deadlines, language tests and other admission requirements, please visit the specific requirements (https://www.uottawa.ca/graduate-studies/programs-admission/apply/specific-requirements/) webpage.

To be eligible, candidates must:
- Have a bachelor's degree in with a specialization, or a major in Biology (or equivalent) with a minimum average of 70% (B).

Note: International candidates must check the admission equivalencies (https://www.uottawa.ca/graduate-studies/international/study-uottawa/admission-equivalencies/) for the diploma they received in their country of origin.

- Demonstrate a good academic performance in previous studies as shown by official transcripts, research reports, abstracts or any other documents demonstrating research skills.
- Meet the funding requirements.

Note: International students must provide proof of financial support: i.e., a stipend provided by a supervisor as well as a combination of awards and/or trust funds.

- Identify at least one professor who is willing to supervise your research and thesis.
- We recommend that you contact potential thesis supervisors as soon as possible.
- To register, you need to have been accepted by a thesis supervisor.
- The supervisor's name is required at the time of application.

Language Requirements

Applicants must be able to understand and fluently speak the language of instruction (French or English) in the program to which they are applying. Proof of linguistic proficiency may be required.

Applicants whose first language is neither French nor English must provide proof of proficiency in the language of instruction.

Note: Candidates are responsible for any fees associated with the language tests.

Notes

- The choice of supervisor will determine the primary campus location of the student. It will also determine which university awards the degree.
- The admission requirements listed above are minimum requirements and do not guarantee admission to the program.
- Admissions are governed by the general regulations (http://www.uottawa.ca/graduate-studies/students/general-regulations/) in effect for graduate studies and by the General Regulations of the Ottawa-Carleton Institute of Biology (OCIB).
- Students must indicate in their initial application for admission to the master's program in biology that they wish to be accepted into the collaborative program in environmental sustainability. Students must be admitted in one of the primary programs participating in the collaborative program. Students will normally be informed about their acceptance into the collaborative program at the same time as being informed about their admission into the primary program. In exceptional cases, students could commence their specialization in environmental sustainability at the beginning of the second term of enrollment.

Program Requirements

Master's with Collaborative Specialization

The primary program may require students to take additional courses, depending on their backgrounds.

Students must meet the following requirements for the master's with collaborative specialization:

Compulsory Course (BIO):
3 optional course units in biology (BIO) at the graduate level 3 Units

The research accomplished by its 140 internationally recognized professors, its approximately 400 graduate students and its dozens of postdoctoral researchers and visiting scientists has positioned the Faculty of Science as one of the most research intensive science faculties in Canada. Our professors have received many international and national awards including three NSERC Gerhard Herzberg Gold Medal winners and numerous Fellows of the Royal Society of Canada.

The Faculty of Science, through its strategic use of infrastructure programs, hosts world-class Core Facilities and is at the leading edge for the study of Catalysis, Experimental and Computational Chemistry, Environmental Toxins, Nuclear Magnetic Resonance, Isotope Analysis, Molecular Biology and Genomics, X-Ray Spectrometry/Diffractometry, Geochemistry, Mass Spectrometry, Physiology and Genetics of Aquatic Organisms, and Photonics. The Faculty is also associated with the Fields Institute for research in mathematical science and the Centre de recherche mathématiques (CRM) at the Université de Montréal, providing a unique setting for mathematical research.

For more information, refer to the list of faculty members and their research fields on Uniweb.

IMPORTANT: Candidates and students looking for professors to supervise their thesis or research project can also consult the website of the faculty or department (https://www.uottawa.ca/graduate-studies/students/academic-unit-contact-information/) of their program of choice. Uniweb does not list all professors authorized to supervise research projects at the University of Ottawa.

Courses
Not all of the listed courses are given each year. The course is offered in the language in which it is described.

A 3-unit course at the University of Ottawa is equivalent to a 0.5-unit course at Carleton University.

**BIO 5101 Topics in Biotechnology (3 units)**
A course concerned with the utilization of biological substances and activities of cells, genes and enzymes in manufacturing, agricultural and service industries. A different topic will be selected each year. This course is equivalent to BIOL 5001 at Carleton University.

**Course Component:** Lecture
Prerequisite: A course in cell physiology or biochemistry, or permission of instructor.

**BIO 5102 Advanced Field Ecology (3 units)**
Field experience in a new environment (e.g. local, national, international) to learn about ecological processes (note extra fees associated with course). This course is equivalent to BIOL 5605 at Carleton University.

**Course Component:** Lecture

**BIO 5103 Advanced Biochemistry (3 units)**
Advanced topics in biochemistry: the chemical structure and function of biological macromolecules, biochemical thermodynamics, metabolism, photosynthesis, lipids and membranes. This course is equivalent to BIOL 5003 at Carleton University.

**Course Component:** Lecture

**BIO 5104 Advances in Applied Biochemistry (3 units)**
Contemporary methods of recombinant DNA technology combined with modern methods and strategies for expressing, secreting, purification and characterizing proteins. This course is equivalent to BIOL 5004 at Carleton University.

**Course Component:** Lecture

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**Seminars:**

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<tr>
<th>Course Code</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIO 5900</td>
<td>MSc Seminar ²</td>
<td>1 Unit</td>
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<tr>
<td>EVD 5100</td>
<td>Seminar in Environmental Sustainability</td>
<td>3 Units</td>
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**Thesis:**

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<th>Course Code</th>
<th>Title</th>
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<tr>
<td>THM 7999</td>
<td>Master’s Thesis ³, ⁴</td>
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**Note(s)**

1. The optional course units may also be selected in related disciplines approved by the Department of Biology.
2. The seminar course involves the presentation of a seminar and regular attendance at the departmental seminars.
3. Presentation and defence of a thesis on a topic in environmental sustainability based on research carried out under the supervision of a professor who is a member of the student’s primary program and/or of the collaborative program. The Collaborative Program Committee determines whether or not the topic of the thesis is appropriate for the designation “Specialization in Environmental Sustainability.” At least one of the thesis examiners must be a member of the Environmental Sustainability collaborative program.
4. Students are responsible for ensuring they have met all of the thesis requirements (http://www.uottawa.ca/graduate-studies/students/theses/).

**Fast-Track from Master’s to PhD**

Students enrolled in the master’s program in Biology at the University of Ottawa may be eligible to fast-track directly into the doctoral program without writing a master’s thesis. For additional information, please consult the “Admission Requirements” section of the PhD program.

**Minimum Requirements**

The passing grade in all courses is B.

Students who fail two courses, or the thesis proposal, or whose research progress is deemed unsatisfactory must withdraw from the program.

**Research**

**Research Fields & Facilities**

Located in the heart of Canada’s capital, a few steps away from Parliament Hill, the University of Ottawa is among Canada’s top 10 research universities.

uOttawa focuses research strengths and efforts in seven Strategic Areas of Development in Research (SADRs):

- Canada and the World
- Health
- e-Society
- Molecular and Environmental Sciences

With cutting-edge research, our graduate students, researchers and educators strongly influence national and international priorities.

**Research at the Faculty of Science**

The Faculty of Science has become a true centre of excellence in research through its world-class professors as well as its programs and infrastructure in Biology, Chemistry, Earth Sciences, Mathematics and Statistics, and Physics.

BIO 5105 Advanced Neuroethology (3 units)
A comparative and evolutionary approach to studying neural mechanisms underlying animal behaviour, including genetic, neural and hormonal influences on behaviour. This course is equivalent to BIOL 5801 at Carleton University.
Course Component: Lecture
Prerequisites: Biology 61.335 and 61.361 or equivalents and registration in a graduate program, or written permission of the department.

BIO 5106 Bioinformatics (3 units)
Major concepts and methods of bioinformatics. Topics may include, but are not limited to genetics, statistics and probability theory, alignments, phylogenetics, genomics, data mining, protein structure, cell simulation and computing. This course is equivalent to BIOL 5506 at Carleton University.
Course Component: Lecture

BIO 5111 Biophysical Techniques (3 units)
Theory and application of current biochemical/biophysical instrumentation and techniques including X-ray crystallography, nuclear magnetic resonance spectrometry, infrared, circular dichroism and fluorescence spectroscopy, isothermal titration and differential scanning calorimetry. This course is equivalent to BIOL 5111 at Carleton University.
Course Component: Lecture

BIO 5121 Advances in Protein Engineering (3 units)
Theory, development and current techniques of protein and enzyme engineering. Topics to be discussed may also include applications in biotechnology, nanotechnology and new frontiers in basic and applied research. This course is equivalent to BIOL 5121 at Carleton University.
Course Component: Lecture

BIO 5128 Molecular Methods (3 units)
An intensive two-week laboratory course where students are introduced to methods such as CRISPR-Cas9 genome editing, in situ hybridization, immunohistochemistry, qRT-PCR and digital droplet PCR.
Course Component: Theory and Laboratory

BIO 5129 Adverse Outcome Pathways: A Framework to Support the Modernization of Chemical Risk Assessment (3 units)
This course will introduce the Adverse Outcome Pathway (AOP) framework and how it can be used to support the integration of modern test methods (e.g. in silico, in vitro, high throughput, etc.) into the chemical risk assessment process. Students will first learn about current practices and recent advances in both human health and ecological chemical risk assessment. Then students will receive an advanced introduction to the AOP framework, including the theory of AOPs, how they can be used in regulatory toxicology for facilitating the use of mechanistic data, test paradigm development, and risk assessment, and training on best practices for contributing to the AOP knowledge base. This will include in-class case studies on AOP development and a final assignment where student will be responsible for developing a novel AOP for a specific toxicity.
Course Component: Lecture

BIO 5130 Ethnobotany and Ethnopharmacology (3 units)
Introduction and current perspectives on world ethnobotanies, traditional knowledge, medicinal and food systems; quantitative and qualitative methods; ethical requirements; pharmacological basis of traditional drugs, phytochemistry, drug discovery and development; safety, risk assessment and regulations.
Course Component: Lecture

BIO 5302 Methods in Molecular Genetics (3 units)
Theory and associated applications of emerging methods in molecular genetics, including information gathered from large-scale genome-wide analysis and protein-protein interaction data, and how this information can advance understanding of cell biology. This course is equivalent to BIOL 5105 at Carleton University.
Course Component: Lecture
Prerequisites: Graduate standing and permission of the department.

BIO 5303 Biological Science in Practice (3 units)
Cross-cutting skills and issues in common to all biological disciplines. Key perspectives on philosophy of science, practical approaches to scientific publication and peer-review, data analysis and presentation, scientific inference, and technical writing will be provided through discipline-specific examples and associated practical work.
Course Component: Lecture

BIO 5305 Biostatistics I (3 units)
Application of statistical analyses to biological data. Topics include ANOVA, regression, GLMs, and may include loglinear models, logistic regression, general additive models, mixed models, bootstrap and permutation tests. This course is equivalent to BIOL 5407 at Carleton University.
Course Component: Lecture

BIO 5306 Modelling for Biologists (3 units)
Use and limitations of mathematical and simulation modelling approaches for the study of biological phenomena. This course is equivalent to BIOL 5409 at Carleton University.
Course Component: Lecture

BIO 5308 Laboratory Techniques in Molecular Genetics (3 units)
Laboratory course designed to give students practical experience in recent important techniques in molecular genetics. This course is equivalent to BIOL 5106 at Carleton University.
Course Component: Lecture

BIO 5309 Advanced Evolutionary Biology (3 units)
Advances in micro-and macroevolution including the mechanisms both driving and constraining evolutionary change, phylogenetic relationships, patterns of evolutionary change at the molecular or phenotypic level, and evolutionary theory and techniques as applied to these areas. This course is equivalent to BIOL 5510 at Carleton University.
Course Component: Lecture

BIO 5310 Advanced Evolutionary Ecology (3 units)
The ecological causes and consequences of evolutionary change, focussing on how the ecological interactions among organisms and their biotic and abiotic environments shape the evolution of phenotypic and species diversity. This course is equivalent to BIOL 5511 at Carleton University.
Course Component: Lecture

BIO 5311 Advanced Evolutionary Ecology (3 units)
The ecological causes and consequences of evolutionary change, focussing on how the ecological interactions among organisms and their biotic and abiotic environments shape the evolution of phenotypic and species diversity. This course is equivalent to BIOL 5511 at Carleton University.
Course Component: Lecture

BIO 5312 Principles and Methods of Biological Systematics (3 units)
Biological systematics with reference to morphological and molecular character evolution and phylogeny reconstruction.
Course Component: Lecture
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tr>
<td>BIO 5314</td>
<td>Advances in Aquatic Sciences (3 units)</td>
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<td>Advanced theoretical and applied aquatic sciences including current topics in limnology and oceanography (e.g. impacts of climate change, invasive species, and atmospheric pollution) with implications for lake, river, coastal and wetland management. This course is equivalent to BIOL 5514 at Carleton University.</td>
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<td>Course Component: Lecture</td>
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<tr>
<td>BIO 5318</td>
<td>Biostatistics II (3 units)</td>
<td></td>
<td>Application of multivariate methods to biological data, including methods such as discriminant functions analysis, cluster analysis, MANOVA, principal components analysis.</td>
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<td>Course Component: Lecture</td>
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<tr>
<td>BIO 5320</td>
<td>Advances in Conservation Biology (3 units)</td>
<td></td>
<td>Interdisciplinary exploration of the science of scarcity and diversity in a human dominated world. This course is equivalent to BIOL 5520 at Carleton University.</td>
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<td>Course Component: Lecture</td>
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<tr>
<td>BIO 5321</td>
<td>Evolutionary Genetics (3 units)</td>
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<td>Genetic mechanisms and processes responsible for variation and evolutionary change in natural populations. Topics may include population and quantitative genetics as applied to protein and genome evolution, molecular phylogenies, DNA sequences in population biology, and the evolution of multigene families. This course is equivalent to BIOL 5521 at Carleton University.</td>
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<td>Course Component: Lecture</td>
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<tr>
<td>BIO 5810</td>
<td>Education Research in Biology (3 crédits)</td>
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<td>An introduction to the science of teaching and learning in biology. Students will be introduced to the foundational concepts in, and tools of, Discipline-Based Education Research (DBER) and will conduct their own DBER research project. This course is equivalent to BIOL 5810 at Carleton University. Includes: Experiential Learning Activities</td>
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<tr>
<td>BIO 5900</td>
<td>Séminaire de maîtrise / MSc Seminar (1 crédit / 1 unit)</td>
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<td>Obligatoire à la maîtrise. L'obtention de crédit est fondée sur la présentation d'un séminaire jugé satisfaisant par le personnel et sur la participation à l'ensemble du cours. / Compulsory for all MSc students. For unit, each student must present one seminar judged to be satisfactory by the staff and must participate in the course as a whole.</td>
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<tr>
<td>BIO 6103</td>
<td>Special Topics in Neuroscience (3 units)</td>
<td></td>
<td>An in-depth study of current topics in neuroscience. Course content varies yearly and has recently included cognitive neuroscience, neuropharmacology, neurodegeneration, and behavioural medicine. Also listed as PSYC 6300. This course is equivalent to BIOL 6203 at Carleton University.</td>
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<tr>
<td>BIO 6300</td>
<td>Advanced Science Communication (3 units)</td>
<td></td>
<td>The theory and practice of effective science communication. Topics may include: writing for, presenting to, and engaging with diverse audiences, as well as graphic design and data visualization, social and digital media, and knowledge mobilization. Experiential Learning Activity: Applied Research. This course is equivalent to BIOL 6500 at Carleton University.</td>
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<tr>
<td>BIO 6303</td>
<td>Advanced Seminar in Neuroscience (3 units)</td>
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<td>A seminar focusing on the active research areas and interests of faculty, guest lecturers and graduate students, and on trends in diverse areas of neuroscience. Also listed as PSYC 6200. This course is equivalent to BIOL 6303 at Carleton University.</td>
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<tr>
<td>BIO 6304</td>
<td>Techniques in Neuroscience (3 units)</td>
<td></td>
<td>Completion of a research project carried out under the supervision of a neuroscience faculty member. The student will learn a new neuroscience technique and apply it to a research objective. May be repeated for different projects. Also listed as PSYC 6204. This course is equivalent to BIOL 6204 at Carleton University.</td>
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<tr>
<td>BIO 6305</td>
<td>Advanced Seminar in Neuroscience (3 units)</td>
<td></td>
<td>A comprehensive pro-seminar series, covering issues ranging from cellular and molecular processes through to neural systems and behaviours as well as psychopathology. Also listed as PSYC 6202. Courses BIO 6305, BIO 6303 (BIO 6303) cannot be combined for units. This course is equivalent to BIOL 6305 at Carleton University.</td>
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<tr>
<td>BIO 8101</td>
<td>Special Topics in Biology (3 units)</td>
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<td>Selected aspects of specialized biological subjects not covered by other graduate courses. This course is equivalent to BIOL 5502 at Carleton University.</td>
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<tr>
<td>BIO 8102</td>
<td>Special Topics in Biology (3 units)</td>
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<td>Selected aspects of specialized biological subjects not covered by other graduate courses. This course is equivalent to BIOL 5502 at Carleton University.</td>
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<tr>
<td>BIO 8103</td>
<td>Special Topics in Biology III (3 units)</td>
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<td>Lectures and/or seminars dealing with current advances in a selected area or branch of biology, not covered by other graduate courses.</td>
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<tr>
<td>BIO 8105</td>
<td>Advances in Applied Ecology (3 units)</td>
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<td>The application of ecological and evolutionary principles in addressing resource management challenges and environmental problems. This course is equivalent to BIOL 5512 at Carleton University.</td>
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<tr>
<td>BIO 8108</td>
<td>Advanced Topics in Development (3 units)</td>
<td></td>
<td>Recent advances in developmental biology. Topics may include embryonic induction, regulation of morphogenesis and differentiation, mechanisms of regional specification and pattern formation, and developmental genetics. This course is equivalent to BIOL 6505 at Carleton University.</td>
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<tr>
<td>BIO 8109</td>
<td>Advanced Molecular Biology (3 units)</td>
<td></td>
<td>In-depth coverage of the structure, function, and synthesis of DNA, RNA, and proteins. This course is equivalent to BIOL 6001 at Carleton University.</td>
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<tr>
<td>BIO 8113</td>
<td>Chemical Toxicology (3 units)</td>
<td></td>
<td>Permissions of the Department is required.</td>
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<tr>
<td>BIO 8116</td>
<td>Advances on Plant Molecular Biology (3 units)</td>
<td></td>
<td>Use of molecular genetics in general plant biology and the contribution of plant genomics to our understanding of plant metabolism, plant development, and plant interactions with the environment at the molecular, genome, and cellular levels. This course is equivalent to BIOL 6002 at Carleton University.</td>
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BIO 8117 Advanced Cell Biology I (3 units)
Recent advances in cell biology, including such topics as membranes, signaling, the cytoskeleton and control of the cell cycle. This course is equivalent to BIOL 6201 at Carleton University.
Course Component: Lecture
Prerequisite: BIO 8118/61.222W1 and this course normally will be offered together in the same year but only in alternate years.

BIO 8118 Advanced Cell Biology II (3 units)
Topics for discussion may include the following: the structure, composition and three-dimensional organization of the nucleus, mechanisms and regulation of genome replication, structural organization of transcription. Nuclear reorganization during gamete development, fertilization, viral infection and the meiotic cell cycle.
Normally offered in alternate years. This course is equivalent to BIOL 6202 at Carleton University.
Course Component: Lecture
Prerequisite: BIO 8117/61.621F1 and this course normally will be offered together in the same year but only in alternate years.

BIO 8120 Directed Studies in Biology (3 units)
One-on-one instruction in selected aspects of specialized biological subjects not covered by other graduate courses. Students may not take this course from their thesis supervisor(s), and are limited to one directed studies course per program. This course is equivalent to BIOL 5502 at Carleton University.
Course Component: Lecture
Prerequisite: In addition to the course material, students will write two terms papers (Alternate years).

BIO 8122 Advanced Insect Biology (3 units)
Overview of the biological processes that allow insects to function in their environments and to overcome the constraints and limitations that the environment places on them. This course is equivalent to BIOL 5307 at Carleton University.
Course Component: Lecture
Prerequisite: In addition to the course material, students will write two terms papers (Alternate years).

BIO 8162 Advanced Endocrinology (3 units)
Major topics in comparative endocrinology: understanding the structure, function and evolution of vertebrate endocrine systems, including endocrine disruption. This course is equivalent to BIOL 5402 at Carleton University.
Course Component: Lecture
Prerequisite: An undergraduate Endocrinology course (BIO 4127 or equivalent).

BIO 8204S Ecology Seminar (3 crédits / 3 units)
Current advances in ecology.
Volet / Course Component: Cours magistral / Lecture

BIO 8301 Evolutionary Bioinformatics (3 units)
Fundamental concepts in molecular evolution and hands-on experience with computer analysis of DNA sequences. Topics may include molecular sequence databases, multiple alignments and phylogenetic trees. This course is equivalent to BIOL 5201 at Carleton University.
Course Component: Lecture
Prerequisite: Graduate standing plus basic courses in genetics and evolution; permission of the department.

BIO 8302 Topics in Evolutionary Genetics (3 units)
A lecture/seminar course on the genetic mechanisms and forces responsible for variation and evolutionary change in natural populations. Topics to include protein and genome evolution, molecular phylogenies, DNA sequences in population biology, and the evolution of multigene families. This course is equivalent to BIOL 5202 at Carleton University.
Course Component: Lecture
Prerequisite: Graduate standing plus basic courses in genetics and evolution; permission of the department (Alternate years).

BIO 8303 Advanced Microscopy (3 units)
Development of the practical skills of microscopy through original research and supporting theory lectures. This course is equivalent to BIOL 5203 at Carleton University.
Course Component: Lecture
Prerequisites: Open to 4th year and graduate students with consent of the instructor.

BIO 8361 Advanced Animal Physiology (3 units)
Recent advances in animal physiology, emphasizing comparative, evolutionary and environmental approaches. This course is equivalent to BIOL 5508 at Carleton University.
Course Component: Lecture
Prerequisite: BIOL 6304 at Carleton University.

BIO 8365 Advanced Behavioural Ecology (3 units)
Recent advances in behavioural ecology including topics such as the evolution of tactics and strategies of group living, foraging, antipredation, resource use and defence, cooperation, reproduction, and parental care. This course is equivalent to BIOL 5508 at Carleton University.
Course Component: Lecture

BIO 8403 Advanced Plant Physiology (4 units)
Course Component: Lecture

BIO 8510 Thèmes choisis en biologie (3 crédits)
Aspects de sujets biologiques spécialisés qui ne sont pas couverts dans d'autres cours d'études supérieures.
Volet : Cours magistral

BIO 8520 Études dirigées en biologie (3 crédits)
Enseignement individualisé sur un sujet biologique spécialisé qui n'est pas couvert dans d'autres cours d'études supérieures. Il est interdit de suivre ce cours avec son directeur de thèse. Limite d'une seule étude dirigée par programme.
Volet : Cours magistral
BIO 8900 Séminaire de doctorat / PhD Seminar
Obligatoire au doctorat. L'obtention de crédit est fondée sur la présentation de deux séminaires jugés satisfaisants par le personnel et sur la participation à l'ensemble du cours. Ce cours est équivalent à BIOL 5501 à la Carleton University. / Compulsory for all PhD students. For unit, each student must present two seminars judged to be satisfactory by the staff and must participate in the course as a whole. This course is equivalent to BIOL 5501 at Carleton University.
Volet / Course Component: Séminaire / Seminar

BIO 8910 Thèmes choisis en biologie / Special Topics in Biology (3 crédits / 3 units)
Aspects de sujets biologiques spécialisés qui ne sont pas couverts dans d'autres cours d'études supérieures. / Selected aspects of specialized biological subjects not covered by other graduate courses.
Volet / Course Component: Cours magistral / Lecture
Prérequis : connaissance passive de l'anglais. / Prerequisite: Passive knowledge of French.

BIO 8938 Interaction entre plantes et animaux / Plant Animal Interactions (3 crédits / 3 units)
Les substances métaboliques secondaires des plantes et leur rôle en tant que phagorépresseurs ou phagostimulants pour les animaux et en tant qu'agents antifongiques ou allélopathiques. On discutera de la coévolution des plantes et des organismes phytophages (insectes et mammifères) et des dimensions physiologique et écologique de cette relation. / Secondary metabolites of plants and their role as attractants or antifeedants to animals and as allelopathic or antifungal agents. Emphasis will be placed on co-evolution of plants and phytophagous organisms such as insects and mammals, and the ecological and physiological dimensions of this relationship. Offered in alternate years. Ce cours est équivalent à BIOL 6404 à la Carleton University. / This course is equivalent to BIOL 6404 at Carleton University.
Volet / Course Component: Cours magistral / Lecture

BIO 8940 Statistiques avancées et science ouverte / Advanced Statistics and Open Science (3 crédits / 3 units)
Les analyses statistiques sont fondamentales à un processus scientifique rigoureux. Par conséquent, il est primordial de comprendre les statistiques et de reporter correctement les analyses pour améliorer la transparence et la qualité de la science. Le cours a pour objectifs: 1) d'améliorer la compréhension des modèles statistique avancés (incluant les modèles mixtes généralisés); 2) de développer de bonnes habitudes pour coder (utilisation de R et Rmarkdown); 3) d'améliorer la gestion des données et du code statistique (manipulation de données et github); et 4) de présenter les principes de science ouverte (se basant sur OSF). / Statistics are a key component of rigorous science and as such there is a need to both understand advanced statistics and properly document the analysis to improve scientific communication transparency and quality. The course aims to 1) provide an understanding of advanced statistical models (including generalized linear mixed models), 2) develop good coding practices (using R and Rmarkdown), 3) improve data and code management (data manipulation and github) and 4) present the principles of open science (using OSF).
Volet / Course Component: Cours magistral / Lecture

BIO 9101 Principles of Toxicology (3 units)
Basic theorems of toxicology with examples of current research problems. The concepts of exposure, hazard and risk assessment will be defined and illustrated with experimental material from some of the more dynamic areas of modern research. This course is equivalent to BIOL 6402 at Carleton University.
Course Component: Lecture

BIO 9104 Ecotoxicology (3 units)
Advances in ecotoxicology with emphasis on the biological effects of contaminants. The potential for biotic perturbation resulting from chronic and acute exposure of ecosystems to selected toxicants will be covered along with the methods, pesticide, herbicide and pollutant residue analysis and the concept of bound residues. This course is equivalent to BIOL 6403 at Carleton University.
Course Component: Lecture
Prerequisite: BIO 9101, CHM 8156.

BIO 9105 Seminar in Toxicology (3 units)
Highlights current topics in toxicology. The student will present a seminar and submit a report on the seminar topic. Student, faculty and invited seminar speakers. This course is equivalent to BIOL 6405 at Carleton University.
Course Component: Lecture

BIO 9107 Toxicology and Regulation (3 units)
This course will help students develop the understanding and skills to apply research results in toxicology to real-world needs for the management of risks posed by environmental contaminants as well as the development of regulation and policy involving such management.
Course Component: Lecture

BIO 9701 Photobiologie (3 crédits)
Interaction de la lumière et des organismes vivants. Étude des sujets suivants : introduction à la photochimie et étude détaillée de la photosynthèse, de la vision, de la photosensibilité et du photopériodisme.
Volet : Cours magistral

BIO 9998 Examen de synthèse / Comprehensive Examination

EVD 5100 Seminar in Environmental Sustainability (3 units)
Overview of environmental sustainability issues using climate change as an example. Application of integrated analyses based on concepts in science, law, economics and policy to devise policy solutions. The debate about the scientific evidence for climate change and international efforts to negotiate an agreement. The economic, political and social dimensions of climate change and measures taken both nationally and internationally to mitigate its effects.
Course Component: Seminar

EVD 5101 Economics of Environmental Law and Policy (3 units)
Environmental issues and the environmental policy framework from an economics perspective. Review of the underlying theory in relation to economic concepts such as efficiency, market failure, externalities, cost-benefit, and valuation. Overview of macroeconomic topics such as economic growth and green accounting, and their relation to law and policy. Application of these theoretical concepts to various environmental challenges, from climate change and energy regulation to managing ecosystem services and conserving biodiversity. Policy options for managing environmental challenges, from traditional command and control regulation to economic instruments such as environmental taxation, and cap and trade programs. Evaluation of the environmental, social, and economic effectiveness of the various policy options, and integration of economic theory into environmental policy development.
Course Component: Lecture

EVD 5109 Applied Environmental Sustainability (3 units)
Uses an environmental sustainability case study, such as climate change, to learn how to synthesize information about a problem from multiple disciplinary perspectives, to critically evaluate such information using rigorous methodological approaches, and to design and evaluate policy or regulatory solutions.
Course Component: Seminar
EVD 5111 Capstone Seminar in Environmental Sustainability (3 units)
Involves partnering with organization(s) working on a sustainability issue. Students work in interdisciplinary teams to identify the scientific, economic, legal and social dimensions of a particular environmental problem, evaluate a set of candidate solutions, and recommend an approach.
Course Component: Seminar

EVD 5113 Foundations of Environmental Policy (3 units)
Study of the key political and administrative factors affecting the formulation and implementation of environmental policy, including democratic institutions, various methods for citizen and stakeholder engagement and their influence on the decision-making process in government, public opinion and the framing of policy problems, values and the use of scientific evidence in policy-making, lobbying and the role of interest representation, federalism and multi-level environmental governance, and the international governance of environmental problems. Case studies will place Canada in a comparative context and explore the importance of political factors across areas of environmental policy.
Course Component: Seminar

EVD 5114 Professional Skills for Environmental Sustainability (1.5 units)
Oral and written communications skills, including presenting to parliamentary committees, preparing memos to cabinet, writing editorials, doing media interviews, and producing interdisciplinary public policy reports. Project and process management skills, including multi-stakeholder processes.
Course Component: Seminar

EVD 5121 Foundations of Environmental Science (3 units)
Provides students with a thematic understanding of the current state of environmental science. Major themes include: the set of environmental issues that are currently of major concern in Canada and abroad; the range of scientific approaches currently employed to understand and predict the effects of human activities on ecosystems; the nature of environmental science evidence; and how environmental sustainability is characterized from the perspective of environmental science.
Course Component: Seminar

EVD 5122 Foundations of Environmental Economics (3 units)
Key elements of economics including formal models and their underlying assumptions as they relate to the development of sustainability policy. Covers concepts such as public goods, market failure, non-market valuation, incentives, welfare economics, regulation, the equity-efficiency trade-off and market-based instruments. The course explains how fundamental economic concepts, particularly their advantages and limitations, are used to analyze issues at the interface of the economy and the environment. Examines renewable (e.g., fisheries, forests) and non-renewable (e.g., oil, gas, minerals) resource management and other topics (e.g., climate change, ozone depletion, cap and trade) in applied environmental economics. Explores the institutions and trade-offs that individuals and governments face in the context of sustainability policy.
Course Component: Seminar

EVD 5123 Evidence Synthesis and Evaluation (3 units)
Reviews different understandings of what constitutes research, both as it pertains to the production of evidence and to the evaluation of existing evidence relating to policy, to regulatory and statutory interventions and to identifying evidence gaps. Students learn research methodologies to design research so as to maximize its evidentiary value (given existing constraints); they will also learn to synthesize and assess the evidentiary value of existing research.
Course Component: Seminar

EVD 5124 Foundations of Environmental Law (3 units)
Foundations of environmental law, including theory of sustainability, constitutional division of powers, approaches to regulation of environmental issues, including examples of legal frameworks for different environmental problems, and access to justice.
Course Component: Seminar

EVD 5500 Séminaire en durabilité de l'environnement (3 crédits)
Survol des enjeux environnementaux et le système de réglementation du point de vue de la science économique. Étude de la théorie qui sous-tend certains concepts économiques, tels l'efficacité, la défaillance du marché, les externalités et la valuation. Survol des concepts macroéconomiques, tels la croissance économique et la comptabilité environnementale. Application de ces concepts théoriques aux défis environnementaux tels le changement climatique, la réglementation de l'énergie, la gestion des services écologiques et la conservation de la biodiversité. Les divers outils de réglementation pour la gestion des défis liés à l'environnement, incluant la réglementation traditionnelle de type « commande et contrôle », les moyens économiques tels que la taxation environnementale et les systèmes de droits d'échanges. Évaluation de l'efficacité environnementale, sociale et économique des diverses approches, et intégration de la théorie économique dans le développement de la réglementation environnementale.
Volet : Séminaire

EVD 5501 Approche économique et le droit de l'environnement (3 crédits)
Les enjeux environnementaux et le système de réglementation du point de vue de la science économique. Étude de la théorie qui sous-tend certains concepts économiques, tels l'efficacité, la défaillance du marché, les externalités et la valuation. Survol des concepts macroéconomiques, tels la croissance économique et la comptabilité environnementale. Application de ces concepts théoriques aux défis environnementaux tels le changement climatique, la réglementation de l'énergie, la gestion des services écologiques et la conservation de la biodiversité. Les divers outils de réglementation pour la gestion des défis liés à l'environnement, incluant la réglementation traditionnelle de type « commande et contrôle », les moyens économiques tels que la taxation environnementale et les systèmes de droits d'échanges. Évaluation de l'efficacité environnementale, sociale et économique des diverses approches, et intégration de la théorie économique dans le développement de la réglementation environnementale.
Volet : Cours magistral

EVD 5509 Développement durable appliqué (3 crédits)
Étude de cas en développement durable (changement climatique, par exemple) pour apprendre à synthétiser l'information sur un problème à partir de plusieurs perspectives disciplinaires, pour évaluer l'information selon un schéma critique, en faisant usage de méthodes rigoureuses, et pour concevoir et évaluer des politiques ou règlements.
Volet : Séminaire

EVD 5511 Séminaire d’intégration sur le développement durable (3 crédits)
Partenariat avec des organisations travaillant en développement durable. Les étudiants forment des équipes multidisciplinaires pour étudier les dimensions scientifiques, économiques, juridiques et sociales d’un problème environnemental particulier, pour évaluer un éventail de solutions possibles et pour recommander les mesures à prendre.
Volet : Cours magistral
Volet : Études des institutions et programmes de compensation auxquels sont liés les enjeux de développement durable. Étude de divers concepts : patrimoine officiel, droits de propiedad, réglementation, équilibre commun; échec des marchés; non évaluation des valeurs courantes; éventail des enjeux environnementaux. Étude de divers concepts : doms, forêts, etc.) et d'autres sujets en économie de l'environnement appliquée (ex. changements climatiques, destruction de la couche d'ozone, programmes de plafonnement et d'échange). Étude des institutions et programmes de compensation auxquels sont confrontés les individus et les gouvernements dans le contexte des politiques de développement durable.

Volet : Cours magistral

EVD 6912 Thèmes choisis en durabilité de l'environnement / Selected Topics in Environmental Sustainability (3 crédits / 3 units)
Analyse approfondie d'une problématique ou d'une question liée aux nouvelles tendances en recherche ou aux nouveaux thèmes de recherche en durabilité de l'environnement.

Volet / Course Component: Cours magistral / Lecture
Préalable : connaissance passive de l'anglais. / Prerequisite: passive knowledge of French
EVD 6932 Lectures dirigées en durabilité de l'environnement / Directed Readings in Environmental Sustainability (3 crédits / 3 units)
Cours individuel ayant pour objectif d'approfondir les connaissances de l'étudiant dans un domaine particulier ou de lui permettre de se familiariser avec un nouveau domaine. Le sujet est déterminé et développé en consultation avec le professeur responsable et en conformité avec les directives de l'Institut de l'environnement. Le travail remis dans ce cours doit être différent de ce qui a pu être soumis dans d'autres cours, y compris le projet de recherche, la thèse ou le mémoire. On permet un maximum d'un cours de lectures dirigées par étudiant et la permission n'est accordée que dans des circonstances exceptionnelles.
*Volet / Course Component: Recherche / Research*
Préalable: Connaissance passive de l’anglais. / Prerequisite: Passive knowledge of French.

EVD 6999 Mémoire / Research Paper (6 crédits / 6 units)
*Volet / Course Component: Recherche / Research*

EVD 7997 Projet de thèse / Thesis Proposal
*Volet / Course Component: Recherche / Research*

EVD 8100 Theory and Practice in Environmental Sustainability (3 units)
Characterization of environmental sustainability from the perspective of economics, political science, environmental science, and law. Demonstration of how often-divergent perspectives and values of stakeholders from various backgrounds frame both sustainability problems themselves, and acceptable solutions.
*Course Component: Seminar*

EVD 8500 Théorie et pratique en durabilité environnementale (3 crédits)
La caractérisation de la durabilité environnementale du point de vue de la science économique, de la science politique, de la science environnementale et du droit. Démonstration de comment les perspectives et les valeurs divergentes des parties prenantes de divers horizons définissent à la fois les problèmes et les solutions acceptables en durabilité.
*Volet: Séminaire*

EVD 8901 Conception de recherche et méthodologie pour la recherche en durabilité de l’environnement / Research Design and Methods for Environmental Sustainability (3 crédits / 3 units)
Vue d'ensemble des méthodes de recherche employées dans les quatre domaines principaux de la durabilité (science de l'environnement, droit, politique et économie). À l'aide d'études de cas, examen des types d'inferences causales que l'on peut ou ne peut pas tirer d'un plan de recherche, les menaces à la déduction valable et les plans de recherche pouvant atténuer ces menaces. Accent particulier sera mis sur la relation entre les conceptions de recherche et la force de l'influence causale. / Overview of research methods employed in the four main subject areas underlying sustainability (environmental science, law, policy and economics). Through case studies, examination of the kinds of causal inferences one can and cannot draw from a research design, threats to valid inference, and research designs that can mitigate those threats. Particular emphasis placed on the relationship between research designs and strength of causal inference.
*Volet / Course Component: Séminaire / Seminar*