DOCTORATE IN PHILOSOPHY BIOLOGY SPECIALIZATION IN CHEMICAL AND ENVIRONMENTAL TOXICOLOGY

Summary
- Degree offered: Doctorate in Philosophy (PhD)
- Registration status option: Full-time
- Language of instruction: English
- Primary program: PhD in Biology
- Collaborative specialization: Chemical and Environmental Toxicology
- Program option (expected duration of the program):
  - with thesis (12 full-time terms; 48 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/).

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 program in Chemical and Environmental Toxicology (at the master's and doctoral levels).

The doctoral program participates in the Combined Program for Degrees in Medicine and Philosophy (MD/PhD). For more information please see the website of the Faculty of Medicine (http://www.med.uottawa.ca/md-phd/eng/).

Collaborative Program Description

Toxicology is the study of effects of toxic substances on living systems. These toxic substances can either be organic or inorganic, synthetic or natural materials. Environmental toxicology further extends to aspects of chemical transport, fate, persistence and biological accumulation of toxic substances and their effects at the population and community levels. While individual researchers usually specialize in a particular area, toxicologists today must be able to appreciate significant research in other fields and therefore require an understanding of the basic principles of other disciplines. To meet this challenge the University of Ottawa and Carleton University offer a joint collaborative program leading to a master of science or a PhD degree with specialization in chemical and environmental toxicology.

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 Environmental Sustainability (MSc)
- Master of Science Biology Specialization in Science, Society and Policy (MSc)
- Doctorate in Philosophy Biology (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/)

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 master’s degree in Biology (or equivalent) with a minimum average of 75% (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.

• Be sponsored into the collaborative specialization by a faculty member of the collaborative program, normally the thesis supervisor, who must be appointed, cross-appointed or stand as an adjunct at the primary program.

• Meet the following additional requirements:
  • Complete a relevant introductory course in toxicology, either:
    • Prior to admission to the collaborative program in chemical and environmental toxicology; or
    • While enrolled in the program by taking one of the two introductory courses (TOX 8156 or TOX 9104).

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 PhD program in biology that they wish to be accepted into the collaborative program in chemical and environmental toxicology. 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.

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, provided the following conditions are met:

• Completion of two graduate courses (6 units) with a grade of A- or better in each; successful completion of the seminar course BIO 5900 (over two terms with one presentation required).

• Satisfactory progress in the research program.
• Written recommendation by the supervisor and the thesis advisory committee.
• Approval by the graduate studies committee.

Note: If the student meets the requirements, the transfer must take place within sixteen months of initial enrollment in the master’s. The minimal admission average requirements for the doctoral program must also be met. Following transfer, all the requirements of the doctoral program must be met.

Program Requirements
Doctorate with Collaborative Specialization
Students must meet the following requirements for the doctorate with collaborative specialization. The units completed for the specialization count also towards the primary program:

The Department may require students to take additional courses depending on their backgrounds.

Compulsory Courses:
3 course units from: 3 Units
   TOX 8156 Principles of Toxicology
   TOX 9104 Ecotoxicology
3 optional course units in biology (BIO) at the graduate level 3 Units
1

Seminars: 2
BIO 8900 PhD Seminar
TOX 9105 Seminar in Toxicology 3

Comprehensive Examination:
BIO 9998 Comprehensive Examination 4

Thesis:
THD 9999 Doctoral Thesis 5, 6

Note(s)
1 The optional course units may also be selected in related disciplines approved by the Department of Biology.
2 The seminar courses involve the presentation of seminars and the regular attendance at the seminars presented by the Department.
3 Students who completed the seminar course TOX 9105 for the master’s specialization are exempted from this requirement.
4 The comprehensive examination must be completed within twelve months of the initial admission into the program.
5 Presentation and defense of a thesis in toxicology based on an original research carried out under the supervision of a faculty member participating in the chemical and environmental toxicology collaborative program.
6 Students are responsible for ensuring they have met all of the thesis requirements (http://www.uottawa.ca/graduate-studies/students/theses/).

Minimum Requirements
The passing grade in all courses is B.

Students who fail 6 units, or the thesis proposal, or the comprehensive exam, or whose 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 four 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.

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/Diffractionometry, 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, purifying
and characterizing proteins. This course is equivalent to BIOL 5004 at
Carleton University.
**Course Component:** Lecture

**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 5301 Fundamentals of Molecular Biology (3 units)**
Theoretical and practical aspects of molecular biology. Concepts of
nucleic acid structure, genome organization, replication, transcription,
translation and expression. This course is equivalent to BIOL 5101 at
Carleton University.
**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 5304 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 5504 at Carleton University.
**Course Component:** Lecture
Prerequisites: A course in cell physiology or biochemistry, or permission of
instructor.

**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
permuation tests. This course is equivalent to BIOL 5407 at Carleton
University.
**Course Component:** Lecture
Prerequisites: Graduate standing, courses in elementary ecology and
statistics and permission of the department.

**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 5307 Advanced Molecular Biology (3 units)**
Theory and applications of molecular biology techniques focussing on
physical and chemical aspects of genome organization, gene expression
and regulation. This course is equivalent to BIOL 5507 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 5508 at Carleton University.
**Course Component:** Lecture
Prerequisites: A course in cell physiology or biochemistry, or permission of
instructor.

**BIO 5309 Advanced Evolutionary Biology (3 units)**
Theory and 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 5310 Advanced Evolutionary Biology (3 units)**
Theory and 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 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
classification and characterizing proteins. This course is equivalent to BIOL
5004 at Carleton University.
**Course Component:** Lecture

**BIO 5313 Advanced Microbial Ecology (3 units)**
Study of microbial diversity, community structure and function in
natural environments. This course is equivalent to BIOL 5512 at Carleton
University.
**Course Component:** Lecture

BIO 5314 Advances in Aquatic Sciences (3 units)
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.
Course Component: Lecture

BIO 5318 Biostatistics II (3 units)
Application of multivariate methods to biological data, including methods such as discriminant functions analysis, cluster analysis, MANOVA, principal components analysis.
Course Component: Lecture

BIO 5320 Advances in Conservation Biology (3 units)
Interdisciplinary exploration of the science of scarcity and diversity in a human dominated world. This course is equivalent to BIOL 5520 at Carleton University.
Course Component: Lecture

BIO 5321 Evolutionary Genetics (3 units)
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.
Course Component: Lecture

BIO 5900 Séminaire de maîtrise / MSc Seminar (1 crédit / 1 unit)
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.
Volet / Course Component: Séminaire / Seminar

BIO 6103 Special Topics in Neuroscience (3 units)
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.
Course Component: Lecture

BIO 6300 Advanced Science Communication (3 units)
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.
Course Component: Lecture

BIO 6304 Techniques in Neuroscience (3 units)
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.
Course Component: Lecture

BIO 6305 Advanced Seminar in Neuroscience (3 units)
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 (BIOL 6303) cannot be combined for units. This course is equivalent to BIOL 6305 at Carleton University.
Course Component: Lecture

BIO 8102 Special Topics in Biology (3 units)
Selected aspects of specialized biological subjects not covered by other graduate courses. This course is equivalent to BIOL 5502 at Carleton University.
Course Component: Laboratory, Lecture

BIO 8104 Selected Topics in Biology III (3 units)
Lectures and/or seminars dealing with current advances in a selected area or branch of biology, not covered by other graduate courses.
Course Component: Lecture

BIO 8105 Advances in Applied Ecology (3 units)
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.
Course Component: Lecture

BIO 8108 Advanced Topics in Development (3 units)
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.
Course Component: Lecture

BIO 8109 Advanced Molecular Biology (3 units)
In-depth coverage of the structure, function, and synthesis of DNA, RNA, and proteins. This course is equivalent to BIOL 6001 at Carleton University.
Course Component: Lecture

BIO 8113 Chemical Toxicology (3 units)
Course Component: Lecture

BIO 8115 Advances on Plant Molecular Biology (3 units)
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.
Course Component: Lecture

Prerequisite: BIO 8109/61.601F1 and this course normally will be offered together in the same year but only in alternate years.
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 mitotic cell cycle. Normally offered in alternate years. This course is equivalent to BIOL 6202 at Carleton University.
Course Component: Lecture
Prerequisite: BIO 8117/61.222W1 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 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 8306 Advanced Topics in Ecology (3 units)
Recent developments in population, community and/or ecosystem ecology. This course is equivalent to BIOL 5508 at Carleton University.
Course Component: Lecture

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

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, anti-predation, resource use and defence, cooperation, reproduction, and parental care. This course is equivalent to BIOL 5802 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 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
Prérequis: BIO 9101, CHM 8156.

BIO 9105 Seminar in Toxicology (3 units)
A one-session course in seminar format highlighting current topics in toxicology. The student will present a seminar and submit a report on the seminar topic. Student, faculty and invited seminar speakers.
Course Component: Seminar

BIO 9106 Genetic Toxicology (3 units)
Topics in mutagenesis and DNA repair, including spontaneous and induced mutagenesis, genetic toxicology testing, the genetics and biochemistry of replication, DNA repair and recombination, and the role of mutagens in the development of genetic disease and cancer. This course is equivalent to BIOL 6406 at Carleton University.
Course Component: Lecture

BIO 9108 Biochemistry (3 units)
The basic theorems of biochemistry of replication, DNA repair and recombination, and the role of mutagens in the development of genetic disease and cancer. This course is equivalent to BIOL 6402 at Carleton University.
Course Component: Lecture
Prérequis: BIO 9101, CHM 8156.

BIO 9998 Examen de synthèse / Comprehensive Examination
Volet / Course Component: Recherche / Research

TOX 8156 Principles of Toxicology (3 units)
The 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

TOX 8157 Chemical Toxicology (3 units)
Advanced course in chemical toxicology dealing with both chemical hazards and exposure. Overview of empirical data relating to the toxicity of various classes of chemicals for test organisms, followed by study of toxicity at the cellular level, including studies of interactions between toxic substances and enzymatic systems. Data applicable to the interpretation and monitoring of WHMIS health regulations. Initial events in enzyme induction and mutagenesis. Study of predictive capabilities in the areas of structure-activity relationships and mechanisms of enzyme induction, followed by assessment of mechanisms of exposure to toxic chemicals.
Course Component: Lecture

TOX 9104 Ecotoxicology (3 units)
Selected topics and 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

TOX 9105 Seminar in Toxicology (3 units)
A one-session course in seminar format highlighting current topics in toxicology. The student will present a seminar and submit a report on the seminar topic. Student, faculty and invited seminar speakers.
Course Component: Seminar

TOX 9106 Genetic Toxicology (3 units)
Topics in mutagenesis and DNA repair, including spontaneous and induced mutagenesis, genetic toxicology testing, the genetics and biochemistry of replication, DNA repair and recombination, and the role of mutagens in the development of genetic disease and cancer. This course is equivalent to BIOL 6406 at Carleton University.
Course Component: Lecture

BIO 9998 Examen de synthèse / Comprehensive Examination
Volet / Course Component: Recherche / Research

TOX 8156 Principles of Toxicology (3 units)
The 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

TOX 8157 Chemical Toxicology (3 units)
Advanced course in chemical toxicology dealing with both chemical hazards and exposure. Overview of empirical data relating to the toxicity of various classes of chemicals for test organisms, followed by study of toxicity at the cellular level, including studies of interactions between toxic substances and enzymatic systems. Data applicable to the interpretation and monitoring of WHMIS health regulations. Initial events in enzyme induction and mutagenesis. Study of predictive capabilities in the areas of structure-activity relationships and mechanisms of enzyme induction, followed by assessment of mechanisms of exposure to toxic chemicals.
Course Component: Lecture

TOX 9104 Ecotoxicology (3 units)
Selected topics and 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

TOX 9105 Seminar in Toxicology (3 units)
A one-session course in seminar format highlighting current topics in toxicology. The student will present a seminar and submit a report on the seminar topic. Student, faculty and invited seminar speakers.
Course Component: Seminar

TOX 9106 Genetic Toxicology (3 units)
Topics in mutagenesis and DNA repair, including spontaneous and induced mutagenesis, genetic toxicology testing, the genetics and biochemistry of replication, DNA repair and recombination, and the role of mutagens in the development of genetic disease and cancer. This course is equivalent to BIOL 6406 at Carleton University.
Course Component: Lecture