DOCTORATE IN PHILOSOPHY BIOLOGY AND SPECIALIZATION BIOINFORMATICS

Overview

Summary

• Degree offered: Doctorate in Philosophy (PhD)
• Registration status option: Full-time
• Language of instruction: English
• Primary program: PhD in Biology
• Collaborative specialization: Bioinformatics
• 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 (https://carleton.ca/biology/ottawa-carleton-institute-of-biology/).

Program Description

The programs prepare candidates for a variety of careers in teaching and research both within and outside of academia. Graduate students are actively involved in laboratory research, course work, and presentation of research seminars. Thus, they acquire autonomy in conducting research and in preparing publications. The programs create a stimulating and challenging environment which will allow students to achieve excellence in research. Graduates of the programs must demonstrate research skills and credibility as professionals in their area of research. The Department is a participating unit in the Bioinformatics collaborative program.

Collaborative Program Description

Bioinformatics is an emerging and increasingly important scientific discipline dedicated to the pursuit of fundamental questions about the structure, function and evolution of biological entities through the design and application of computational approaches. Fundamental research in these areas is expected to increase our understanding of human health and disease which translates into innovation in industry. Bioinformaticians today must be able to appreciate significant research in other fields and therefore require an understanding of the basic principles of other disciplines. The degree awarded specifies the primary program and indicates "specialization in Bioinformatics."

Main Areas of Research

• Molecular and cellular biology
• Microbiology
• Genomics, transcriptomics, and proteomics
• Ecology and evolution
• Environmental toxicology

Other Programs Offered Within the Same Discipline of in a Related Area

• 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 x 3145
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 especific-requirements/) webpage.
To be eligible, candidates must:

- Have a master's degree in science (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.

- The requirements outlined above are a minimum. The Admission Committee reserves the right to add any course considered essential in light of the student's background. The courses BNF 5106 and/or BNF 6100 could be added to the student's program requirements.

- 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 thesis director must be a member of the collaborative program.

Language Requirements

Applicants must be able to understand and fluently speak the language of instruction 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 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.

- Students must indicate in their initial application for admission to the master's program in Biochemistry that they wish to be accepted into the collaborative program in Bioinformatics. 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.

- 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.

Fast-Track from Master’s to PhD

Students enrolled in the master's program in Biology with specialization in Bioinformatics 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:

- Maintain an A- average during their graduate studies and in the last two years of undergraduate studies.
- Complete all the core courses required for the M.Sc.
- Demonstrate a satisfactory progress in the research program.
- Provide a written recommendation by the thesis supervisor.
- Provide a written recommendation by the Departmental Graduate Studies Committee.

Note: The transfer must take place within sixteen months of initial enrollment in the master's. Please note that the minimal admission average requirements for the doctoral program must also be met. Following transfer, all of the requirements of the doctoral program must be met.

Program Requirements

Doctorate with specialization

Students must meet the following requirements:

Optional Courses:
- 6 optional course units in biology (BIO) or bioinformatics (BNF) at the 5000 or 8000 level (1,2,3)

Seminars:
- BIO 8900 PhD Seminar 4
- BNF 8166 Seminar in Bioinformatics 5

Comprehensive Examination:
- BIO 9998 Comprehensive Examination

Thesis
- THD 9999 Doctoral Thesis 6,7

Note(s)

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

2. Students in the PhD with specialization in bioinformatics program who already have taken BNF 5106 will be required to take one of BCH 5101, BCH 8110, BIO 8301, BNF 5107, or CHM 8309.

3. The optional course units may be selected from other approved graduate courses in related disciplines approved by the Department.

4. This requirement involves the presentation of a seminar and regular attendance at the departmental seminars.

5. The seminar course in bioinformatics involves a written report, the presentation of a seminar, and regular attendance at departmental seminars.

6. Successful presentation and defence of a research thesis on a topic in bioinformatics based on original research carried out under the supervision of a faculty member participating in the bioinformatics collaborative program.

7. Students are responsible for ensuring they have met all of the thesis requirements.
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/Diffactometry, 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

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
Prerequisites: Biology 61.335 and 61.361 or equivalents and registration in a graduate program, or written permission of the department.

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

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.

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.

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.

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.

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, bootstrap and permutation 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 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
Prerequisites: Graduate standing and permission of the department.

BIO 5310 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 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

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 multigenic families. This course is equivalent to BIOL 5521 at Carleton University.
Course Component: Lecture

BIO 5810 Education Research in Biology (3 crédits)
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
Volet : Cours magistral
Permission of the Director or Associate Director of OCIB

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
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<th>Course Component</th>
<th>Title</th>
<th>Prerequisite</th>
<th>Credits</th>
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<td><strong>BIO 6103</strong></td>
<td>Special Topics in Neuroscience (3 units)</td>
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<td><strong>Course Component</strong>: Lecture</td>
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<td><strong>BIO 6300</strong></td>
<td>Advanced Science Communication (3 units)</td>
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<td><strong>BIO 8104</strong></td>
<td>Techniques in Neuroscience (3 units)</td>
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<td><strong>BIO 8109</strong></td>
<td>Advanced Molecular Biology (3 units)</td>
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<td><strong>BIO 8113</strong></td>
<td>Chemical Toxicology (3 units)</td>
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<td><strong>BIO 8116</strong></td>
<td>Advances on Plant Molecular Biology (3 units)</td>
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<td><strong>Course Component</strong>: Lecture</td>
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<td><strong>BIO 8117</strong></td>
<td>Advanced Cell Biology I (3 units)</td>
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<tr>
<td><strong>BIO 8118</strong></td>
<td>Advanced Cell Biology II (3 units)</td>
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<td><strong>BIO 8119</strong></td>
<td>Directed Studies in Biology (3 units)</td>
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<td><strong>BIO 8120</strong></td>
<td>Special Topics in Biology (3 units)</td>
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<td><strong>BIO 8122</strong></td>
<td>Advanced Insect Biology (3 units)</td>
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<td><strong>BIO 8123</strong></td>
<td>Advanced Endocrinology (3 units)</td>
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This is a copy of the 2022-2023 catalog.
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 8320 Advanced Plant Biology (3 units)
Recent developments in plant biology. Topics may include plant anatomy, systematics, evolution, genetics, ecology, ethnobotany, cell biology, and/or biotechnology. This course is equivalent to BIOL 6300 at Carleton University.
Course Component: Lecture
Prerequisite: Biology 61.425 and Biology 61.426/427, or permission of the department.

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 satisfaits 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 allelopathiques. 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 statistiques 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

BNF 5106 Bioinformatique (3 crédits)
Concepts et méthodes en bioinformatique. Les sujets abordés peuvent inclure, entre autres, la génétique, les statistiques et les théories des probabilités, les alignements, la phylogénétique, la génomique et la structure de protéines.
Volet : Cours magistral

BNF 6100 MSc Seminar (3 units)
Current topics in bioinformatics presented by program professors and invited speakers. Oral presentation and written report required. Graded S (Satisfactory) / NS (Not satisfactory).
Course Component: Lecture

BNF 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.

BNF 8766 Séminaire en bioinformatique (3 crédits)
Sujets courants en bioinformatique présentés par des étudiants en PhD et des conférenciers invités. Présentation orale requise. Noté S (satisfaisant) ou NS (non satisfaisant).
Volet : Séminaire

BNF 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.

BNF 8766 Séminaire en bioinformatique (3 crédits)
Sujets courants en bioinformatique présentés par des étudiants en PhD et des conférenciers invités. Présentation orale requise. Noté S (satisfaisant) ou NS (non satisfaisant).
Volet : Séminaire