MASTER OF SCIENCE BIOLOGY SPECIALIZATION IN BIOINFORMATICS

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: Bioinformatics
- 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).

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

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. To meet this challenge Carleton University and the University of Ottawa offer a collaborative program leading to a master of science degree in the primary program with specialization in Bioinformatics or, in the case of computer science, a master of computer science degree with specialization in Bioinformatics.

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 Environmental Sustainability (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)

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.
- 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.

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. 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.

Program Requirements
Master’s with Collaborative Specialization
The primary program may require students to take additional courses, depending on their backgrounds.

The units completed for the specialization count also towards the primary program.

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 1

Compulsory Course (BNF):
BNF 5106 Bioinformatics 3 Units

Seminars:
BIO 5900 MSc Seminar 2 1 Unit
BNF 6100 MSc Seminar 3 3 Units

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 5003 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

---

**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

---

**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**

---

**Thesis:**

**THM 7999** Master’s Thesis

**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. The seminar course in bioinformatics involves a written report, the presentation of a seminar, and regular attendance at departmental seminars.
4. 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.
5. Students are responsible for ensuring they have met all of the thesis requirements (http://www.uottawa.ca/graduate-studies/students/theses).

---

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 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 logistic regression, genetic additive models, mixed 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 multigene families. This course is equivalent to BIOL 5521 at Carleton University.
Course Component: Lecture

BIO 5900 Séminaire de maîtrise / MS 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 6303 Advanced Seminar in Neuroscience (3 units)
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.
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 6304 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 6302. 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 6302 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 6305 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 6305 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 6303 Advanced Seminar in Neuroscience (3 units)
Overview of the biological processes that allow insects to function in the environment places on them. This course is equivalent to BIOL 5307 at Carleton University.
Course Component: Lecture

BIO 6103 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 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 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 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
Volet / Course Component: Recherche / Research

BNF 5106 Bioinformatics (3 units)
Major concepts and methods of bioinformatics. Topics may include, but are not limited to: genetics, statistics & probability theory, alignments, phylogenetics, genomics, data mining, protein structure, cell simulation and computing.

Course Component: Lecture

BNF 5107 Applied Bioinformatics (3 units)
Computational knowledge discovery in and the dynamic nature of cellular networks. Includes, but is not limited to, knowledge representation, large scale data integration, data mining and computational systems biology. This course is equivalent to BIOL 5516 at Carleton University.

Course Component: Lecture

BNF 5506 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 6500 Séminaire de maîtrise (3 crédits)
Sujets courants en bioinformatique présentés par des professeurs membres du programme et des conférenciers invités. Présentation orale et rapport écrit requis. Noté S (satisfaisant) ou NS (non satisfaisant).

Volet : Cours magistral