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.

Admission Requirements

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 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.

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):**

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<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tr>
<td>BIO 5900</td>
<td>MSc Seminar</td>
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<tr>
<td>BIO 6100</td>
<td>MSc Seminar</td>
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**Compulsory Course (BNF):**

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<tr>
<td>BNF 5106</td>
<td>Bioinformatics</td>
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Seminars:

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The Faculty of Science as one of the most research intensive science faculties in Canada. Our professors have received many international and national awards including three NSERC Gerhard Herzberg Gold Medal winners and numerous Fellows of the Royal Society of Canada.

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

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

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

Courses

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

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

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

**Course Component:** Lecture

Prerequisite: A course in cell physiology or biochemistry, or permission of instructor.

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

**Course Component:** Lecture

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

**Course Component:** Lecture

**BIO 5104 Advances in Applied Biochemistry (3 units)**
Contemporary methods of recombinant DNA technology combined with modern methods and strategies for expressing, secreting, 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 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 linear models, logistic regression, general additive models, mixed models, bootstrap and permutation tests. This course is equivalent to BIOL 5407 at Carleton University.
Course Component: Lecture
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 / 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 6104 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. This course is equivalent to BIOL 5502 at Carleton University.
Course Component: Laboratory, Lecture

BIO 6108 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 6109 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 8116 Advances on Plant Molecular Biology (3 units)
Course Component: Lecture

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 8118/61.622W1 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 8118/61.622W1 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

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

Volet / Course Component: 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 8308 Advanced Plant Physiology (4 units)
Course Component: Lecture
Prerequisite: BIOL 6403 at Carleton University.

BIO 8310 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 8312 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 8340 Advanced Plant Physiology (4 units)
Course Component: Lecture

BIO 8350 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 co-évolution 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 perturbance 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 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