

Biology

This section presents the requirements for programs in:

- **M.Sc. Biology**
- **M.Sc. Biology with Collaborative Specialization in Biochemistry**
- **M.Sc. Biology with Collaborative Specialization in Bioinformatics**
- **M.Sc. Biology with Collaborative Specialization in Chemical and Environmental Toxicology**
- **M.Sc. Biology with Collaborative Specialization in Data Science**
- **Ph.D. Biology**
- **Ph.D. Biology with Collaborative Specialization in Biochemistry**
- **Ph.D. Biology with Collaborative Specialization in Chemical and Environmental Toxicology**

Program Requirements

M.Sc. Biology (5.0 credits)

Requirements:

1. 1.0 credit in approved coursework	1.0
2. 0.5 credit in:	0.5
BIOL 5000 [0.5] Introduction to Graduate Studies	
3. 3.5 credits in:	3.5
BIOL 5909 [3.5] M.Sc. Thesis (including successful oral defence)	

Total Credits 5.0

M.Sc. Biology with Collaborative Specialization in Biochemistry (5.0 credits)

Requirements:

1. 1.0 credits in:	1.0
BIOL 5002 [0.5] Seminar in Biochemistry	
BIOL 5004 [0.5] Advances in Applied Biochemistry	
4. 4.0 credits in:	4.0
BIOL 5909 [3.5] M.Sc. Thesis (in the specialization, including successful oral defence)	

Total Credits 5.0

M.Sc. Biology with Collaborative Specialization in Bioinformatics (5.0 credits)

Requirements:

1. 1.0 credit in:	1.0
BIOL 5515 [0.5] Bioinformatics	
BIOL 5517 [0.5] Bioinformatics Seminar	
2. 4.0 credits in:	4.0
BIOL 5909 [3.5] M.Sc. Thesis (in the specialization, including successful oral defence)	

Total Credits 5.0

Bioinformatics-Related Courses

Biology

BIOL 5105 (BIO 5302) Methods in Molecular Genetics
BIOL 5201 (BIO 8301) Evolutionary Bioinformatics
BIOL 5409 (BIO 5306) Modelling for Biologists
BIOL 5501 (BIO 8120) Directed Studies in Biology
BIOL 5502 (BIO 8102) Selected Topics in Biology
BIOL 5516 (BNF 5107) Applied Bioinformatics

Biomedical Engineering

BIOM 5405 (BMG 5305) Pattern Classification and Experiment Design

Computer Science

COMP 5306 (CSI 5100) Data Integration
COMP 5307 (CSI 5101) Knowledge Representation
COMP 5704 (CSI 5131) Parallel Algorithms and Applications in Data Science
COMP 5703 (CSI 5163) Algorithm Analysis and Design
COMP 5108 (CSI 5126) Algorithms in Bioinformatics

Mathematics and Statistics

STAT 5708 (MAT 5170) Probability Theory I
STAT 5709 (MAT 5171) Probability Theory II
STAT 5703 (MAT 5181) Data Mining
STAT 5702 (MAT 5182) Modern Applied and Computational Statistics
STAT 5600 (MAT 5190) Mathematical Statistics I
STAT 5501 (MAT 5191) Mathematical Statistics II
MATH 6507 (MAT 5319) Topics in Probability

Systems and Computer Engineering

SYSC 5104 (ELG 6114) Methodologies For Discrete-Event Modeling And Simulation
SYSC 5703 (ELG 6173) Integrated Database and Cloud Systems

M.Sc. Biology with Collaborative Specialization in Chemical and Environmental Toxicology (5.0 credits)

Requirements:

1. 1.5 credits in:	1.5
BIOL 6405/ CHEM 5805 [0.5] Seminar in Toxicology	
BIOL 6402/ CHEM 5705 [0.5] Principles of Toxicology	
or BIOL 6403/ CHEM 5708 [0.5] Ecotoxicology	
and 0.5 credit in additional approved coursework	
2. 3.5 credits in:	3.5

BIOL 5909 [3.5]	M.Sc. Thesis (in the specialization, including successful oral defence)
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Total Credits	5.0
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M.Sc. Biology with Collaborative Specialization in Data Science (5.0 credits)

Requirements:

1. 0.5 credit in approved coursework	0.5
2. 0.5 credit in:	0.5
DATA 5000 [0.5] Introduction to Data Science	
3. 4.0 credits in:	4.0
BIOL 5909 [3.5] M.Sc. Thesis (in the specialization, including successful oral defence)	

Total Credits	5.0
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Note:

- Completion of the graduate courses specified by the student's advisory committee and the director or associate director of the OCIB is required. These are normally two one-term courses, but additional courses may be required, depending on the background and research program of the student.
- The passing grade for all required courses is 70% or the equivalent, and the student is not allowed a supplemental examination.
- The admissions committee or the student's advisory committee may also direct the student to take or to audit additional courses. Knowledge of a second language may be specified as a requirement.
- Completion of at least two terms as a full-time student resident at one of the two universities is normally required. Programs for part-time students may be arranged.
- Presentation of one public seminar on the candidate's thesis research is required.
- Completion of a thesis incorporating the results of original research carried out under the direct supervision of an approved faculty member is required.
- Successful oral defence of the thesis before an examination board of at least four faculty members, normally drawn from both universities, is required.

Ph.D. Biology (1.5 credits)

Requirements:

1. 1.0 credit in approved coursework	1.0
2. 0.5 credit in:	0.5
BIOL 5000 [0.5] Introduction to Graduate Studies	
3. 0.0 credits in:	0.0
BIOL 6909 [0.0] Ph.D. Thesis (including successful oral defence)	

Total Credits	1.5
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Ph.D. Biology with Collaborative Specialization in Biochemistry (1.0 credit)

Requirements:

1. 1.0 credit in:	1.0
BIOL 5002 [0.5] Seminar in Biochemistry	

BIOL 5004 [0.5]	Advances in Applied Biochemistry
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or, for students who have already completed BIOL 5002 and/or BIOL 5004, select from the following:

BIOL 5105 [0.5]	Methods in Molecular Genetics
BIOL 5106 [0.5]	Laboratory Techniques in Molecular Genetics
BIOL 5502 [0.5]	Selected Topics in Biology
3. 0.0 credits in:	0.0
BIOL 6909 [0.0]	Ph.D. Thesis (in the specialization, including successful oral defence)

Total Credits	1.0
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Ph.D. Biology with Collaborative Specialization in Chemical and Environmental Toxicology (1.5 credits)

Requirements:

1. 1.0 credit in:	1.0
BIOL 6405/ CHEM 5805 [0.5]	Seminar in Toxicology
BIOL 6402/ CHEM 5708 [0.5]	Principles of Toxicology
or BIOL 6403 [0.5]	Ecotoxicology
or CHEM 5705 [0.5]	Ecotoxicology
2. 0.5 credit in additional course work	0.5
2. 0.0 credits in:	0.0
BIOL 6909 [0.0]	Ph.D. Thesis (in the specialization, including successful oral defence)

Total Credits	1.5
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Note:

- Completion of the graduate courses specified by the student's advisory committee and the director or associate director of the OCIB is required. These will normally be two one-term courses (four one-term courses if transferred to the Ph.D. program without completing the M.Sc.).
- Only graduate courses may form part of the candidate's course requirements.
- The passing grade for all required courses is 70%, and the student is not allowed a supplemental examination.
- The admissions committee or the student's advisory committee may also direct the student to take or to audit additional courses. Knowledge of a second language may be specified as a requirement.
- Scheduling of an oral Qualifying Examination within approximately 12 months of entry into the program and completion normally within 18 months is required; this examination will cover the candidate's area of research, and related topics. The format of the examination will be established by the departmental graduate committee. The examination committee generally will be composed of faculty members of both universities.
- Presentation of at least one public seminar on the candidate's thesis research is required.
- A thesis incorporating the results of original research carried out under the direct supervision of an approved faculty member is required.

- Completion of at least four terms as a full-time student resident at one of the two universities (or six terms if transferred from an M.Sc.) is required. Under exceptional conditions programs may be arranged for part-time students.
- Successful oral defence of the thesis is required before an examination board of at least five faculty members is required, with representation from both universities, and including an external examiner from outside the two universities who is an authority on the thesis research area.

Regulations

See the General Regulations section of this Calendar.

Guidelines for Completion of Master's Degree

The maximum time limits for the completion of the requirements of the master's program are listed in the General Regulations, Section 13 of this Calendar.

Full-time candidates in the master's program are expected to complete their degree requirements within six terms of first registration for full-time study.

Part-time candidates in the master's program are expected to complete their degree requirements within four calendar years or twelve terms from the initial registration in the master's program.

Regulations

See the General Regulations section of this Calendar.

Guidelines for Completion of the Doctoral Degree

The maximum time limits for the completion of the program requirements of the doctoral program are listed in the General Regulations, Section 13 of this Calendar.

Full-time candidates in the doctoral program are expected to schedule their oral Qualifying Examination within approximately 12 months of entry into the program, and to complete it within 18 months of entry into the program.

Part-time candidates in the doctoral program are expected to schedule their oral Qualifying Examination within approximately 18 months after entry into the program.

Full-time candidates are expected to complete their degree requirements within four (4) calendar years or 12 terms of registered full-time study.

Doctoral candidates who have transferred from the master's to the doctoral program without completing the master's program are expected to complete their degree requirements within four (4) calendar years or 12 terms of registered full-time study from initial registration in the master's program.

Part-time candidates in the doctoral program are expected to complete their degree requirements within six (6) calendar years or 18 terms after the date of initial registration.

Admission

M.Sc. Biology

An Honours B.Sc. or equivalent degree at a standard acceptable to the two universities is required for admission to the M.Sc. program.

Applicants with acceptable standing in a non-honours degree may be admitted to a qualifying-year program which will be determined in each case by the admissions committee.

Applicants must demonstrate a fluent knowledge of English (Carleton), or either English or French (Ottawa).

M. Biotechnology

Bachelor of Science (or equivalent) in a life sciences field, with B+ or higher in major subjects and B- or higher overall.

Ph.D. Biology

An M.Sc. from a recognized university is required for entry to the Ph.D. program.

A student already registered for the M.Sc. may be permitted to transfer to the Ph.D. program following a recommendation by the departmental graduate committee and successful completion of the Qualifying Examination required of Ph.D. candidates.

All applicants must demonstrate a fluent knowledge of English (Carleton), or either English or French (Ottawa).

Biology (BIOL) Courses

BIOL 5000 [0.5 credit]

Introduction to Graduate Studies

This course will provide students with hands-on experience to develop skills that will contribute to a successful graduate experience. Topics/activities will include program expectations, proposal development, mentorship and teaching, scholarship and networking opportunities, and science communication (oral and written).

Includes: Experiential Learning Activity

Prerequisite(s): Admission to graduate program (MSc or PhD) in Biology at Carleton.

BIOL 5001 [0.5 credit] (BIO 5101)

Topics in Biotechnology

A course concerned with the use of biological substances and activities of cells, genes, and enzymes in manufacturing, agricultural, and service industries. A different topic will be selected each year.

Includes: Experiential Learning Activity

Prerequisite(s): a course in cell physiology or biochemistry, or permission of the instructor and permission of the director or associate director of OCIB.

BIOL 5002 [0.5 credit] (BIO 5107)**Seminar in Biochemistry**

A graduate seminar on current topics in the field of Biochemistry. This course introduces the seminar format and involves student, faculty and invited seminar speakers. The student will present a seminar and submit a report on a current topic in Biochemistry.

Includes: Experiential Learning Activity

Also listed as CHEM 5800.

BIOL 5004 [0.5 credit] (BIO 5104)**Advances in Applied Biochemistry**

A practical hands-on course in the field of Biochemistry. This course is run in a laboratory and will train students in highly specialized technique(s) in Biochemistry. The students will run experiments, gather data, assess and analyze the results and present the findings as a seminar.

Includes: Experiential Learning Activity

Also listed as CHEM 5806.

BIOL 5104 [0.5 credit] (BNF 5104)**Bioinformatics Laboratory**

Principles of organization, retrieval, manipulation, and analysis of molecular data in genomics, proteomics and transcriptomics. Hands-on analysis of these data to solve biological questions using quantitative and computational methods.

Includes: Experiential Learning Activity

BIOL 5105 [0.5 credit] (BIO 5302)**Methods in Molecular Genetics**

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.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5106 [0.5 credit] (BIO 5308)**Laboratory Techniques in Molecular Genetics**

Laboratory course designed to give students practical experience in recent important techniques in molecular genetics.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5111 [0.5 credit] (BIO 5111)**Biophysical Techniques**

Theory and application of current biochemical/ biophysical instrumentation and techniques including X-ray crystallography, nuclear magnetic resonance spectrometry, infrared, circular dichroism and fluorescence spectroscopy, and isothermal titration and differential scanning calorimetry.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5128 [0.5 credit] (BIO 5128)**Molecular Methods**

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.

Includes: Experiential Learning Activity

BIOL 5144 [0.5 credit] (BIO 5144)**Plant Molecular Biology**

Introduction to plant gene structure and function, cloning into plants and the manipulation of plant genes. Elements of plant biochemistry, physiology and molecular biology combined with an emphasis on practical research.

BIOL 5158 [0.5 credit] (BIO 5158)**Applied Biostatistics**

Applied biostatistics to real problems. Experimental design and data collection. Consequences of violating assumptions of different tests. Monte Carlo and Bootstrap analysis. Case studies and exercises in using statistical analysis packages.

Includes: Experiential Learning Activity

BIOL 5201 [0.5 credit] (BNF 8301)**Evolutionary Bioinformatics**

Basic concepts in molecular evolution and hands-on experience with the computer analysis of DNA sequences. Topics may include molecular sequence databases, multiple alignments and phylogenetic trees.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5203 [0.5 credit] (BIO 8303)**Advanced Microscopy**

Development of the practical skills of microscopy through original research and supporting theory lectures.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5300 [0.5 credit] (BIO 5130)**Ethnobotany and Ethnopharmacology**

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.

BIOL 5304 [1.0 credit]**Fundamentals in Neuroscience**

A comprehensive neuroscience course from cellular levels to neural systems and behaviour. Topics covered include aspects of neuroanatomy, neurophysiology, neuropharmacology and behavioural and cognitive neuroscience.

Also listed as NEUR 5100.

Precludes additional credit for PSYC 5200.

BIOL 5307 [0.5 credit] (BIO 8122)**Advanced Insect Biology**

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.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5313 [0.5 credit] (BIO 5313)**Topics in Evolutionary and Comparative Biology**

Workshop and hands-on training to develop broad basis and familiarity with the research toolkit of modern biology. Topics include the use of statistical programs, 3D data acquisition and analysis, cladistic analysis and phylogenetic comparative method, microscopy and histology, basic bioinformatics, , and scientific illustration.

BIOL 5402 [0.5 credit] (BIO 8162)**Advanced Endocrinology**

Major topics in comparative endocrinology: understanding the structure, function and evolution of vertebrate endocrine systems, including endocrine disruption.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5404 [0.5 credit] (BIO 5109)**Biological Data Science in R**

Develops the practical skills needed to work with large and complex datasets, as a complement to statistical methods. Topics include programming, quality control, tidy data, visualization, project organization, reproducibility, how to troubleshoot code, and how to translate research goals into a project pipeline.

Includes: Experiential Learning Activity

Prerequisite(s): a course in statistics at the undergraduate level, or permission of the director or associate director of OCIB.

BIOL 5407 [0.5 credit] (BIO 5305)**Biostatistics I**

Application of statistical analyses to biological data.

Topics include ANOVA, regression, GLMs, and may include loglinear models, logistic regression, general additive models, mixed models, bootstrap and permutation tests.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5408 [0.5 credit] (BIO 5108)**Bayesian Statistics for Biologists**

Introduction to the philosophy of Bayesian inference; practical experience applying to biological data. Model formulation, identification of appropriate priors and resulting posteriors given priors and data, and the practice of drawing inferences from these posteriors.

Includes: Experiential Learning Activity

Prerequisite(s): An advanced course in applied biostatistics (e.g. BIOL 5407) or permission of the Department and good standing in a Carleton University Biology or Biochemistry Graduate Program.

BIOL 5409 [0.5 credit] (BIO 5306)**Modelling for Biologists**

Use and limitations of mathematical and simulation modelling approaches for the study of biological phenomena.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5501 [0.5 credit] (BIO 8120)**Directed Studies in Biology**

One-to-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.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5502 [0.5 credit] (BIO 8102)**Selected Topics in Biology**

Lecture and seminar courses in selected aspects of specialized biological subjects not covered by other graduate courses.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5506 [0.5 credit] (BIO 5213)**Principles and Methods of Biological Systematics**

Biological systematics with reference to morphological and molecular character evolution and phylogeny reconstruction.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5510 [0.5 credit] (BIO 5310)**Advanced Evolutionary Biology**

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.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5511 [0.5 credit] (BIO 5311)**Advanced Evolutionary Ecology**

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.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5512 [0.5 credit] (BIO 8105)**Advances in Applied Ecology**

The application of ecological and evolutionary principles in addressing resource management challenges and environmental problems.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5514 [0.5 credit] (BIO 5314)**Advances in Aquatic Sciences**

Advanced theoretical and applied aquatic sciences including current topics in limnology and oceanography (e.g. impacts of climate change, invasive species, atmospheric pollution) with implications for lake, river, coastal and wetland management.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5515 [0.5 credit] (BNF 5106)**Bioinformatics**

Major concepts and methods of bioinformatics. Topics may include genetics, statistics and probability theory, alignments, phylogenetics, genomics, data mining, protein structure, cell simulation and computing.

Includes: Experiential Learning Activity

BIOL 5516 [0.5 credit] (BNF 5107)**Applied Bioinformatics**

Introduction to programming for students in the life sciences. Through lectures, assignments, and independent projects, students will learn about basic concepts and techniques in programming, including variables, control structures, subroutines, and input/output. No previous knowledge of bioinformatics or programming is required.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of Ottawa-Carleton Institute for Biology.

BIOL 5517 [0.5 credit] (BNF 6100)**Bioinformatics Seminar**

Current topics in bioinformatics. Students must successfully complete a presentation and written report.

BIOL 5518 [0.5 credit] (BNF 5318)**Biostatistics II**

Application of multivariate methods to biological data, including methods such as discriminant functions analysis, cluster analysis, MANOVA, principle components analysis.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5520 [0.5 credit] (BIO 5320)**Advances in Conservation Science**

Interdisciplinary exploration of the science of scarcity and diversity in a human dominated world.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5526 [0.5 credit] (BIO 5126)**Analysis of Next-generation Sequence Data**

Assembly and analysis of next-generation sequence (NGS) data. Through hands-on exercises and independent projects, students will learn to use tools for quality control, assembly, mutation calling, and other NGS applications. No previous knowledge of bioinformatics or programming is required.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the Director or Associate Director of OCIB.

BIOL 5605 [0.5 credit] (BIO 5102)**Advanced Field Ecology**

Field experience in a new environment (e.g., local, national, international) to learn about ecological processes (note - extra fees associated with course).

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5709 [0.5 credit] (TOX 8157)**Chemical Toxicology**

An introduction to modeling chemical hazards and exposures at the cellular level. The properties of toxic substances are compared to the responses of enzymatic systems. These interactions are defined as Quantitative Structure-Activity Relationships and used to interpret hazardous materials under regulations such as WHMIS.

Also listed as CHEM 5709/CHM 8157.

Prerequisite(s): BIOL 6402/CHEM 5708 (TOX 9156/CHM 8156), and permission of the director or associate director of OCIB.

BIOL 5801 [0.5 credit] (BIO 5105)**Advanced Neuroethology**

A comparative and evolutionary approach to studying neural mechanisms underlying animal behaviour, including genetic, neural and hormonal influences on behaviour.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 5802 [0.5 credit] (BIO 8365)**Advanced Behavioural Ecology**

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.

Prerequisite(s): Either BIOL 3802 or BIOL 3804 or equivalent AND permission of the director or associate director of OCIB.

BIOL 5900 [1.0 credit]**Problems and Opportunities in Biotechnology**

Identification of problems, solutions and opportunities in regional biotechnology industries. Lectures and workshops explore challenges of regional startup and established biotechnology companies.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the Department and good standing in a Carleton University biology or biochemistry graduate program.

BIOL 5901 [1.0 credit]**Development of a Novel Biotechnology Product**

Capstone course. Under faculty supervision, students will either design and develop a start-up venture in their area of interest, or carry out an internship with a regional biotechnology company. Theory of business and entrepreneurship will be reinforced throughout. Graded SAT/UNS.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the Department and good standing in a Carleton University biology or biochemistry graduate program.

BIOL 5909 [3.5 credits]**M.Sc. Thesis**

Includes: Experiential Learning Activity

BIOL 6001 [0.5 credit] (BIO 8109)**Advanced Molecular Biology**

In-depth coverage of the structure, function, and synthesis of DNA, RNA, and proteins.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6002 [0.5 credit] (BIO 8116)**Advances in Plant Molecular Biology**

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.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6040 [0.5 credit] (BIO 8940)**Advanced Statistics and Open Science**

The course aims to provide an understanding of advanced statistical models (including generalized linear mixed models), to develop good coding practices (using R and Rmarkdown), to improve data and code management (data manipulation and github) and present the principles of open science (using OSF).

Lectures

BIOL 6115 [0.5 credit] (BIO 8115)**Genomics in Graduate Studies**

Applying tools of genomics in the current research environment. Students will build an original research proposal that includes genomics analyses distinct from those they currently use. The goal is to investigate how genomics (broadly defined) can help students tackle and/or uncover new questions in research.

BIOL 6203 [0.5 credit] (BIO 6103)**Special Topics in Neuroscience**

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 NEUR 5800.

BIOL 6204 [0.5 credit] (BIO 6304)**Techniques in Neuroscience**

Completion of a research project carried out under the supervision of a neuroscience faculty member, normally not the current supervisor. The student will learn a new neuroscience technique and apply it to a research objective. Students must obtain prior approval from the graduate committee.

Also listed as NEUR 6301, NEUR 6302.

Precludes additional credit for PSYC 6204.

BIOL 6300 [0.5 credit] (BIO 8320)**Advanced Plant Biology**

Recent developments in plant biology. Topics may include plant anatomy, systematics, evolution, genetics, ecology, ethnobotany, cell biology, and/or biotechnology.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6304 [0.5 credit] (BIO 8361)**Advanced Animal Physiology**

Recent advances in animal physiology, emphasizing comparative, evolutionary and environmental approaches. Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6305 [1.0 credit] (BIO 6305)**Advanced Seminar in Neuroscience**

A comprehensive pro-seminar series, covering issues ranging from cellular and molecular processes through to neural systems and behaviours as well as psychopathology. Students will also be required to attend the neuroscience colloquia series as part of this course.

Also listed as NEUR 6100.

Precludes additional credit for PSYC 6200, PSYC 6202, PSYC 6203.

Prerequisite(s): BIOL 5304 or equivalent.

BIOL 6306 [0.5 credit]**Adv Seminar in Neuroscience II**

A comprehensive pro-seminar series, covering issues ranging from cellular and molecular processes through to neural systems and behaviours as well as psychopathology.

Prerequisite(s): BIOL 6305.

BIOL 6402 [0.5 credit] (CHM 8156, TOX 8156)**Principles of Toxicology**

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.

Also listed as CHEM 5708.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6403 [0.5 credit] (CHM 9109, TOX 9104)**Ecotoxicology**

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 methods of pesticide, herbicide and pollutant residue analysis.

Also listed as CHEM 5705.

BIOL 6404 [0.5 credit] (BIO 8938)**Plant: Animal Interactions**

The biology of co-evolutionary relationships between plants and phytophagous animals.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6405 [0.5 credit] (TOX 9105)**Seminar in Toxicology**

A seminar course 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.

Includes: Experiential Learning Activity

Also listed as CHEM 5805.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6406 [0.5 credit] (BIO 9106)**Genetic Toxicology**

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.

Includes: Experiential Learning Activity

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6500 [0.5 credit] (BIO 6300)

Advanced Science Communication

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.

Includes: Experiential Learning Activity

BIOL 6505 [0.5 credit] (BIO 8108)

Advanced Topics in Development

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.

Offered in alternate years.

Prerequisite(s): permission of the director or associate director of OCIB.

BIOL 6909 [0.0 credit]

Ph.D. Thesis

Includes: Experiential Learning Activity