

# Biology (BIOL)

---

## Biology (BIOL) Courses

### BIOL 1010 [0.5 credit]

#### Biotechnology and Society

A course for students interested in the science behind recent advances in biotechnology. The different ways in which biotechnology is being applied in agriculture, health care, and the environment will be examined. Preclusion: credit will not be given if taken concurrently with, or after BIOL 2200 or BIOC 2200 or BIOL 2201. Students in Biology and Biochemistry programs may only take this course as a free elective.

Lectures three hours a week.

### BIOL 1103 [0.5 credit]

#### Foundations of Biology I

A research-oriented course focusing on the scientific process of biological exploration at the cellular level. Topics include cell organization, metabolism, genetics, and reproduction.

Precludes additional credit for BIOL 1003 (no longer offered).

Prerequisite(s): Ontario 4U/M in Biology (or equivalent), or Ontario 4U/M in Chemistry (or equivalent).

Lectures three hours a week, laboratory or tutorial three hours a week.

### BIOL 1104 [0.5 credit]

#### Foundations of Biology II

A research-oriented course focusing on the scientific process of biological exploration at the macroscale.

Topics include evolution, diversity of life, and ecological relationships.

Precludes additional credit for BIOL 1004 (no longer offered).

Prerequisite(s): Ontario 4U/M in Biology (or equivalent) or BIOL 1103.

Lectures three hours a week, laboratory or tutorial three hours a week.

### BIOL 1105 [0.5 credit]

#### Biological Methods, Analysis and Interpretation

Formulation of biological research questions, development of hypotheses and predictions, design of experiments, collection and analysis of data, interpretation and presentation of results.

Lectures three hours a week.

### BIOL 1902 [0.5 credit]

#### Natural History

A course designed primarily for students in non-biology programs to investigate the natural history of plants and animals, and the communities in which they occur. Particular attention is paid to the Ottawa region, but appropriate examples from other locales are also included.

Lectures three hours a week.

### BIOL 2001 [0.5 credit]

#### Animals: Form and Function

An introduction to the diverse structures of animals (both invertebrates and vertebrates) in relationship to their functions, discussed within an evolutionary framework.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week, laboratory or tutorial three hours a week.

### BIOL 2002 [0.5 credit]

#### Plants: Form and Function

An introduction to the structure and development of higher plants (at cellular, morphological and organism levels) discussed in relation to their function.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week, laboratory or tutorial three hours a week.

### BIOL 2005 [0.5 credit]

#### Human Physiology

Topics may include: neurophysiology, sensory reception, the skeletal system, muscular contraction, the cardiovascular system, the respiratory system, and the gastrointestinal system. Preclusion: credit will not be given if taken concurrently with, or after BIOL 3305 or BIOL 3306. Students in Biology and Biochemistry programs may only take this course as a free elective.

Prerequisite(s): BIOL 1003 or BIOL 1103 and (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or permission of the Department.

Lectures three hours a week.

### BIOL 2104 [0.5 credit]

#### Introductory Genetics

A lecture and laboratory course on the mechanisms of inheritance and the nature of gene structure, composition and function, introducing both classical Mendelian genetics and modern molecular genetics. It is strongly recommended that this course be taken by Biology majors in their second year of study.

Precludes additional credit for BIOL 2106 (no longer offered) and BIOL 2107. Credit for BIOL 2106 will only be given if taken before BIOL 2104.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week, laboratory or tutorial three hours a week.

### BIOL 2107 [0.5 credit]

#### Fundamentals of Genetics

Mechanisms of inheritance and the nature of gene structure, composition and function, introducing both classical Mendelian genetics and modern molecular genetics.

Precludes additional credit for BIOL 2104 and BIOL 2106 (no longer offered).

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week.

**BIOL 2200 [0.5 credit]****Cellular Biochemistry**

Cellular functions and their interrelationships. Introduction to thermodynamics, membrane structure and function, transport mechanisms, basic metabolic pathways, energy production and utilization, communications between cells. It is strongly recommended that Biology Majors and Honours students take this course in their second year of study.

Also listed as BIOC 2200.

Precludes additional credit for BIOL 2201.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104), (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006), or permission of the Department.

Lectures three hours a week, laboratory or tutorial four hours a week.

**BIOL 2201 [0.5 credit]****Cell Biology and Biochemistry**

A study of the molecular, metabolic and structural organization of cells in relation to function. This course is recommended for students not taking upper year Biology laboratory courses for which BIOL/BIOC laboratories are prerequisites.

Precludes additional credit for BIOL 2200, BIOC 2200.

Prerequisite(s): (BIOL 1003 or BIOL 1103) and (CHEM 1002 or CHEM 1006), or permission of the Department.

Lectures three hours a week.

**BIOL 2301 [0.5 credit]****Biotechnology I**

An introductory course on the science, technology, entrepreneurial skills and business considerations related to biotechnology. The course will survey broadly across the disciplines of Biology, including applications in agriculture, health, environment and industry.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the department.

Lectures and workshops three hours a week

**BIOL 2303 [0.5 credit]****Microbiology**

The biology of the bacteria, Archaea, Viruses and Protozoans, from the fundamentals of cell chemistry, molecular biology, structure and function, to their involvement in ecological and industrial processes and human disease.

Also listed as ENVE 2002.

Prerequisite(s): BIOL 1003 or BIOL 1103.

Lectures three hours a week.

**BIOL 2600 [0.5 credit]****Introduction to Ecology**

The scientific study of interactions of living organisms and their environment, and how these affect the distribution and abundance of life. Topics include energy transformation and flow, nutrient cycling, population and community dynamics, human impacts on ecosystems, conservation issues. Laboratory includes field and computer exercises.

Prerequisite(s): (BIOL 1003 and BIOL 1004), or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week, laboratory or tutorial four hours a week.

**BIOL 2903 [0.5 credit]****Natural History and Ecology of Ontario**

Introduction to the remarkable diversity and ecological relationships of Ontario's flora and fauna, which are explored in a habitat context.

Precludes additional credit for BIOL 1903 (no longer offered).

Prerequisite(s): BIOL 1004 or BIOL 1104 or BIOL 1902.

Lectures three hours a week.

**BIOL 3004 [0.5 credit]****Insect Diversity**

Introductory course dealing with the taxonomic diversity, anatomy, behavior and physiology of insects, as well as their impacts on ecosystems, agriculture and animal and human health.

Precludes additional credit for BIOL 4601.

Prerequisite(s): BIOL 2001.

Lectures three hours a week.

**BIOL 3008 [0.5 credit]****Bioinformatics**

A practical exploration in the application of information technology to biochemistry and molecular biology. Insight into biological knowledge discovery via molecular structure and function prediction, comparative genomics and biological information management.

Also listed as BIOC 3008, COMP 3308.

Prerequisite(s): BIOC 2200 or BIOL 2200, or permission of the Department.

Lectures two hours a week, computer workshop three hours a week.

**BIOL 3102 [0.5 credit]****Mycology**

This introductory course will cover the morphology, physiology, life cycles, evolution, ecology and biotechnology of the fungi.

Prerequisite(s): BIOL 2104 or BIOL 2107.

Lectures three hours a week.

**BIOL 3104 [0.5 credit]****Molecular Genetics**

A lecture course dealing with modern advances in molecular genetics.

Prerequisite(s): BIOL 2104 or BIOL 2107 or permission of the Department.

Lectures three hours a week.

**BIOL 3201 [0.5 credit]****Cell Biology**

A lecture and laboratory course on the structure, composition, and function of eukaryotic cells.

Prerequisite(s): BIOL 2104 and BIOL 2200/BIOC 2200, or permission of the Department.

Lectures three hours a week, laboratory four hours a week.

**BIOL 3202 [0.5 credit]****Principles of Developmental Biology**

Introduction to the underlying principles and mechanisms governing development in multicellular animals and plants. Differentiation, growth, morphogenesis, and patterning will be examined at the organismal, cellular, and molecular levels to provide a balanced view of developmental phenomena in key model organisms.

Prerequisite(s): BIOL 2104 or BIOL 2107 and one of BIOL 2001 or BIOL 2002, or permission of the Department.

Lectures three hours a week.

**BIOL 3205 [0.5 credit]****Plant Biochemistry and Physiology**

A lecture and laboratory course consisting of selected topics in metabolism and physiology of plants, including photosynthesis, nutrient uptake and transport, intermediary and secondary metabolism, germination, growth and development.

Prerequisite(s): BIOL 2002 and BIOL 2200/BIOC 2200, or permission of the Department.

Lectures three hours a week, laboratory four hours a week.

**BIOL 3301 [0.5 credit]****Biotechnology II**

An interdisciplinary course on interactions between science, invention and innovation in biotechnology. Case studies related to regional biotechnology opportunities; social and ethical issues impacting biotechnology.

Prerequisite(s): BIOL 2301 or (BIOL 2104 and BIOL 2200/BIOC 2200) or permission of the department.

Lectures and laboratory/workshops three hours a week

**BIOL 3303 [0.5 credit]****Experimental Microbiology**

Intensive training in laboratory techniques in microbiology, using bacteria and other microorganisms to demonstrate processes of cell growth, metabolism, gene expression, rapid evolution, gene transfer, microbial community dynamics and interactions with other organisms.

Prerequisite(s): BIOL 2104, BIOL 2200/BIOC 2200 and BIOL 2303, or permission of the Department.

Lecture/tutorial one and a half hours a week, laboratory four hours a week.

**BIOL 3305 [0.5 credit]****Human and Comparative Physiology**

The properties of physiological systems and components of humans and other animals with an emphasis on physical and chemical bases.

Precludes additional credit for BIOL 3306.

Prerequisite(s): BIOL 2200/BIOC 2200 and BIOL 2001. A credit in PHYS at the 1000-level is strongly recommended. Lectures three hours a week, laboratory four hours a week.

**BIOL 3306 [0.5 credit]****Human Anatomy and Physiology**

The anatomy and physiology of the neuromuscular, cardiovascular, respiratory, and excretory systems of humans with comparison to other animals.

Precludes additional credit for BIOL 3305.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104), and (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006).

Lectures three hours per week.

**BIOL 3307 [0.5 credit]****Advanced Human Anatomy and Physiology**

The anatomy and physiology of the endocrine, skeletal, digestive, immunological, and reproductive systems, with additional emphasis on the embryological origins of the major physiological systems.

Prerequisite(s): BIOL 3305 or BIOL 3306.

Lectures three hours per week, workshop or laboratory four hours per week.

**BIOL 3501 [0.5 credit]****Biomechanics**

Properties of muscles, tendons, bones, joints and the co-ordinated use of these structures. Human and other animal locomotion and fitness, bird flight, especially the soaring of the vulture and the albatross, and animal migration are covered in detail.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104).

Lectures three hours a week, workshop two hours a week.

**BIOL 3601 [0.5 credit]****Ecosystems and Environmental Change**

Exploration of the unique contribution of the ecosystem approach to ecology, and of early key literature in ecosystem ecology through to current work on global environmental change.

Prerequisite(s): BIOL 2600.

Lectures three hours a week, laboratory four hours a week in six sessions.

**BIOL 3602 [0.5 credit]****Conservation Biology**

The science of biology as applied to the problem of maintaining species diversity. Topics include: history of conservation biology, valuation of species, indices of biodiversity, extinction, conservation genetics, conservation planning in parks and reserves, landscape ecology and case studies of conservation problems.

Prerequisite(s): BIOL 2600 or permission of the Department.

Lectures three hours a week and laboratory/workshop three hours a week.

**BIOL 3604 [0.5 credit]****Analysis of Ecological Relationships**

Introduction to the analysis of ecological data. Students analyze real ecological data sets in weekly laboratory sessions. Methods introduced include simple linear, polynomial, and multiple regression analysis, analysis of variance, nonparametric tests, tests of independence and logistic regression analysis.

Prerequisite(s): BIOL 2600 and STAT 2507.

Lectures one and one-half hours and laboratory two and one-half hours a week.

**BIOL 3605 [0.5 credit]****Field Course I**

An intensive study of living organisms under natural conditions. Credit is based on two weeks of full-time fieldwork with attendant assignments. A wide range of modules is available. Transportation and room and board costs are borne by the student. Students may take both BIOL 3605 and BIOL 3606 for credit, but neither may be used to repeat a particular module.

Also listed as NEUR 3203, for animal behaviour modules only.

Prerequisite(s): at least one course in BIOL beyond the 1000-level and written permission of the Department.

All day, approximately six days a week.

**BIOL 3606 [0.5 credit]****Field Course II**

An intensive study of living organisms under natural conditions. Credit is based on two weeks of full-time fieldwork with attendant assignments. A wide range of modules is available. Transportation and room and board costs are borne by the student. Students may take both BIOL 3605 and BIOL 3606 for credit, but neither can be used to repeat a particular module.

Prerequisite(s): at least one course in BIOL beyond the 1000-level and written permission of the Department.

All day, approximately six days a week.

**BIOL 3608 [0.5 credit]****Principles of Biogeography**

Contemporary and past controls on distribution of plants and animals at global, regional and local scales; significance of these distributions.

Also listed as GEOG 3104.

Prerequisite(s): BIOL 2600 or GEOG 1010 or permission of the Department.

Lectures, laboratory, and fieldwork five hours a week.

**BIOL 3609 [0.5 credit]****Evolutionary Concepts**

Evolution is the change in population properties across generations. Genetic variation, mutation, selection, drift, gene flow, genome evolution, speciation, development, biodiversity, fossils, and macro-evolution.

Prerequisite(s): BIOL 2104 or BIOL 2107 or permission of the instructor.

Lectures three hours a week.

**BIOL 3611 [0.5 credit]****Evolutionary Ecology**

The term "adaptation" is meaningful only with respect to an ecological context. Ecological contexts lead to evolutionary outcomes such as diverse mating systems, ageing, sexual reproduction, sexual dimorphism, geographic variation, phenotypic plasticity, and diverse life histories.

Precludes additional credit for BIOL 4608.

Prerequisite(s): BIOL 2600.

Lectures three hours a week; one field trip.

**BIOL 3612 [0.5 credit]****Computational Methods in Ecology and Evolution**

Introduction to the development and use of computer programs to address biological problems. Topics include the development of programs to analyse ecological data, models of population dynamics, deterministic chaos, cellular automata, simulations of foraging behaviour and evolutionary computation.

Prerequisite(s): BIOL 2600 or permission of the Department.

Lectures two hours per week, workshop three hours per week.

**BIOL 3801 [0.5 credit]****Plants and Herbivores**

Exploration of the chemical, physiological, ecological and evolutionary interactions that underlie the relationship between plants and their insect herbivores.

Prerequisite(s): BIOL 2001 and BIOL 2002.

Lectures/seminars three hours a week.

**BIOL 3802 [0.5 credit]****Animal Behaviour**

Advanced study of animal behaviour including the environmental, genetic, and neural influences on behaviour. Topics such as predator-prey interactions, mating behaviour, migration, parental care and social interactions are interpreted in an evolutionary context.

Prerequisite(s): BIOL 2001 or BIOL 2600 or permission of the Department.

Lectures and workshop/tutorials three hours a week.

**BIOL 3804 [0.5 credit]****Social Evolution**

Diversity in social behaviour from evolutionary and ecological perspectives. Topics include ecological determinants of social living, social networks, social foraging, inclusive fitness, kin selection, altruism, cooperation, and mating systems and strategies.

Prerequisite(s): BIOL 2001 and BIOL 2600, or permission of the Department.

Lectures three hours a week.

**BIOL 3901 [0.5 credit]****Research Proposal**

The development of a competitive research proposal in consultation with an advisor.

Prerequisite(s): third year standing in an Honours Biology program and permission of the Department.

**BIOL 3902 [0.5 credit]****Topics in Biology I**

Specific topics of current interest. Topics may vary from year to year.

Prerequisite(s): third-year standing in a Biology program or permission of the Department.

Lecture, seminars, or workshops three hours per week.

**BIOL 3999 [0.0 credit]****Co-operative Work Term Report**

Practical experience for students enrolled in the Co-operative Option. Students must receive satisfactory evaluations from their work term employer. Written reports describing the work term project will be required. Graded Sat or Uns.

Prerequisite(s): registration in the Biology Co-operative Option and permission of the Department.

**BIOL 4008 [0.5 credit]****Molecular Plant Development**

Recent advances in plant development including molecular, biochemical, genomics, and proteomics studies.

Prerequisite(s): BIOL 2002 or permission of the Department.

Lectures three hours a week.

**BIOL 4102 [0.5 credit]****Molecular Ecology**

The interface of molecular biology, ecology and population biology. Topics include experimental design and a survey and critique of molecular genetic methods to study ecology.

Prerequisite(s): BIOL 2104 or BIOL 2107 and BIOL 2600; BIOL 3104 or one of BIOL 3601, BIOL 3602 (may be taken concurrently), or permission of the Department.

Lectures three hours a week.

**BIOL 4103 [0.5 credit]****Population Genetics**

Evolution of gene frequencies, including selection, mutation, genetic drift, inbreeding, gene flow, and population structure.

Prerequisite(s): BIOL 2104 or BIOL 2107 or permission of the Department. A course in statistics is highly recommended.

Lectures and seminars three hours a week.

**BIOL 4104 [0.5 credit]****Evolutionary Genetics**

An overview of the molecular evidence of evolution, speciation as well as the phylogenetic analysis of biological sequence data and biometrical traits.

Prerequisite(s): (BIOL 2001 or BIOL 2002) and (BIOL 2104 or BIOL 2107) or permission of the Department. A course in statistics is recommended.

Lectures and computer lab three hours a week.

**BIOL 4106 [0.5 credit]****Advances in Molecular Biology**

Review of the application of high throughput approaches to research in molecular and cellular biology and biochemistry with an emphasis on gene function and human disease progression.

Prerequisite(s): BIOL 2303 and (BIOL 3104 or BIOL 3201).

Lectures and seminars three hours a week.

**BIOL 4109 [0.5 credit]****Laboratory Techniques in Molecular Genetics**

This laboratory course provides practical familiarity with commonly used techniques in molecular genetics. The laboratory is suitable for students with a developing interest in problems of molecular and cellular biology and biochemistry.

Prerequisite(s): BIOL 2200/BIOC 2200 and BIOL 2303 and BIOL 3104 or permission of the Department.

Lecture/laboratory six hours a week in two sessions.

**BIOL 4200 [0.5 credit]****Immunology**

The organization and function of the immune system, including the anatomy of the immune system, the properties and behaviour of cells of the immune system, and the molecular and genetic bases of the immune response.

Also listed as BIOC 4200.

Prerequisite(s): BIOL 3201 or permission of the Department.

Lectures three hours a week.

**BIOL 4201 [0.5 credit]****Advanced Cell Culture and Tissue Engineering**

Theory and application of current techniques and developments in cell culture as applied to research questions in the field of stem cells and tissue engineering. Also listed as BIOC 4201.

Prerequisite(s): BIOL 3201 or permission of the Department.

Laboratory four hours per week, tutorial one hour a week. Labs require regular participation outside of the scheduled lab time to maintain cell cultures and set up or complete experiments.

**BIOL 4202 [0.5 credit]****Mutagenesis and DNA Repair**

A mechanistic study of mutagenesis and DNA repair. Topics include DNA structure perturbations, spontaneous and induced mutagenesis, the genetics and biochemistry of DNA repair and recombination, and the role of mutations in the development of genetic disease and cancer.

Also listed as BIOC 4202.

Prerequisite(s): BIOL 3104 and BIOL 2200/BIOC 2200 or permission of the Department.

Lectures and tutorial three hours a week.

**BIOL 4203 [0.5 credit]****Evolution of Sex**

The evolution of sex, including meiosis, syngamy, sex determination, sex chromosomes, and gender from organismal, genetic, and developmental perspectives; the origin, maintenance, function, and ubiquity of sex.

Prerequisite(s): BIOL 2104 or BIOL 2107.

Lectures three hours a week.

**BIOL 4206 [0.5 credit]****Human Genetics**

A survey of human genetic variation and mutation in a molecular genetics context. Topics may include molecular basis of diseases, chromosomal abnormalities, genomic imprinting, cancer genetics, genomics, gene mapping and gene therapy.

Prerequisite(s): BIOL 3104 or permission of the Department.

Lectures three hours a week.

**BIOL 4207 [0.5 credit]****Advanced Embryology & Developmental Biology**

A laboratory-based exploration of techniques and recent developments in the use of model embryological systems as applied to questions of development and human health.

Prerequisite(s): BIOL 3201 or BIOL 3202 or permission of the Department.

Laboratory four hours per week, tutorial one hour a week. Labs require regular participation outside of the scheduled lab time to set up or complete experiments.

**BIOL 4209 [0.5 credit]****Advanced Plant Physiology**

An advanced course dealing with recent developments in selected topics of plant physiology.

Prerequisite(s): BIOL 3205 and CHEM 2203, CHEM 2204 or permission of the Department.

Lectures/discussion three hours a week.

**BIOL 4300 [0.5 credit]****Applied Microbiology**

Studies of the application of microorganisms. Topics may include: microbial communities, and agricultural, pharmaceutical, industrial and health sciences.

Prerequisite(s): (BIOL 2200/BIOC 2200 or BIOL 2201), BIOL 2303 and (BIOL 3104 or BIOL 3303) or permission of the Department.

Lectures and tutorial three hours a week.

**BIOL 4301 [0.5 credit]****Current Topics in Biotechnology**

Explorations of developing biotechnologies in areas such as microbial products, protein engineering, plant genetic engineering, environmental remediation, pharmaceuticals production and medical diagnostics and therapy.

Prerequisite(s): BIOL 3301 or (BIOL 2104 or BIOL 2107) and (BIOL 2200/BIOC 2200 or BIOL 2201,) or permission of the department.

Lectures and tutorials three hours a week.

**BIOL 4303 [0.5 credit]****Advances in Microbiology**

Exploration of current microbiology including the biology of infectious agents, microbial and functional genomics and proteomics. Special attention will be paid to the "big questions" in the field. Students will be exposed to proposing research to answer a specific question in microbiology.

Prerequisite(s): BIOL 2303 and (BIOL 3104 or BIOL 3303 or BIOC 3102) or permission of the Department.

Lectures three hours per week.

**BIOL 4306 [0.5 credit]****Animal Neurophysiology**

A course dealing with recent advances made in particular areas of animal neurophysiology.

Precludes additional credit for BIOL 4305.

Prerequisite(s): BIOL 3305 or BIOL 3306, or permission of the Department.

Lectures two hours a week, workshops or laboratory four hours a week.

**BIOL 4309 [0.5 credit]****Studies in Human Performance**

Biomechanical underpinnings of human performance including the quantitative analysis of human motion in normal activities and in athletic performance. Students will learn modern motion capture methods. This course will require students to design and execute an independent project.

Prerequisite(s): BIOL 3307 and fourth-year standing, or permission of the department.

Lecture three hours per week, workshop/labs three hours per week.

**BIOL 4317 [0.5 credit]****Neuroethology: The Neural Basis of Animal Behaviour**

The proximate mechanisms underlying animal behaviour are examined focusing on how nervous systems evolve in response to environmental selection pressures.

Topics include genetic and hormonal influences on behaviour (e.g. maternal care), unique sensory worlds (e.g. magnetic), and various levels of neural integration, from simple reflexes to complex social behaviour.

Prerequisite(s): BIOL 3305 or BIOL 3306, or permission of the Department.

Lectures three hours a week.

**BIOL 4318 [0.5 credit]****Adaptations to Extreme Environments**

Lectures, discussions and student presentations will be used to examine adaptations of animals to extreme environments (e.g. desert) or lifestyles (e.g. diving), at the physiological, biochemical and molecular levels. Emphasis on becoming familiar with the current primary literature.

Prerequisite(s): BIOL 3305, or permission of the Department.

Lectures three hours a week, workshop two hours a week.

**BIOL 4319 [0.5 credit]****Studies in Exercise Physiology**

Physiological mechanisms underlying human athletic performance. Exercise physiology and cardio-respiratory activity, metabolic regulation and musculoskeletal function. Practical experience will be gained in the workshop/laboratory based experimental sessions.

Prerequisite(s): BIOL 3307 and fourth-year standing, or permission of the department.

Lectures two hours per week, workshop/labs three hours per week.

**BIOL 4500 [0.5 credit]****Ornithology I**

Introduction to ornithology, the study of birds; the evolution of birds, migration, geographic variation, adaptations for flight, feeding, reproduction; extinction and preservation.

Prerequisite(s): BIOL 2001.

Lectures three hours per week.

**BIOL 4501 [0.5 credit]****Ornithology II**

The taxonomy of birds and species identification are learned through the use of study skins in the lab. Field excursions allow first-hand study of wintering species. Participants must acquire a pair of binoculars and one of the recommended field guides.

Prerequisite(s): BIOL 4500.

Laboratory/field excursions four hours per week.

**BIOL 4502 [0.5 credit]****Herpetology**

Herpetology is the study of amphibians and reptiles. The behaviours, physiological ecology, conservation and identification of amphibians and reptiles will be examined through lectures, seminars and hands-on activities.

Prerequisite(s): BIOL 2001.

Lectures or seminars three hours per week.

**BIOL 4503 [0.5 credit]****Fish Ecology, Conservation and Management**

Introduction to the diversity and environmental biology of the world's fishes. Applied issues in fisheries management, conservation, and aquaculture. Workshops expose students to techniques in fisheries science through hands-on demonstrations and field excursions.

Prerequisite(s): BIOL 2600 or permission of the Department.

Lectures/seminars two hours a week, plus labs/workshops two hours a week.

**BIOL 4504 [0.5 credit]****Ecology of Freshwater Invertebrates**

Overview of the diversity and ecology of freshwater invertebrates. Aquatic invertebrates from local bodies of water will be sampled and identified in the lab. Experiments on the ecology and behaviour of model species of freshwater invertebrates will also be conducted in the lab.

Prerequisite(s): BIOL 2001 and BIOL 2600.

Seminar and lab four hours a week.

**BIOL 4602 [0.5 credit]****Evolutionary Applications across Disciplines: From Medicine to Conservation**

Evolutionary principles contributing to advancements across fields including medicine, agriculture, conservation, climate change, and engineering. Topics include evolution of virulence, causes of variation in human health, evolution of resistance to pesticides, interventions for recovery of species at risk, and biomimetic modeling in engineering and architecture.

Prerequisite(s): BIOL 1104 and third-year standing.

Lectures/workshops three hours per week.

**BIOL 4603 [0.5 credit]****Insect Evolution and Biology**

Major questions on the origin, evolution and adaptation of structures and physiology of terrestrial arthropods, especially insects.

Prerequisite(s): BIOL 3004, or permission of the Department.

Lectures two hours a week, laboratory four hours a week.

**BIOL 4604 [0.5 credit]****Landscape Ecology**

Landscape ecology is the study of how landscape structure affects the abundance and distribution of organisms. The focus of this course is on research methods and results in landscape ecology. Applications in forestry, agriculture, and species conservation.

Prerequisite(s): BIOL 2600 or equivalent, BIOL 3601 or BIOL 3602 or BIOL 3608 or equivalent, and honours standing in Biology, Geography, or Environmental Sciences.

Lecture three hours a week.

**BIOL 4802 [0.5 credit]****Advanced Animal Behaviour**

Contemporary issues in behavioural ecology. Topics may include the relevance of behavioural ecology to conservation biology, to new insights into human social behaviour, and will be selected through consultation between professor and students.

Prerequisite(s): BIOL 3802 or BIOL 3804, or permission of the Department.

Lectures two hours a week, laboratory four hours a week.

**BIOL 4900 [1.0 credit]****Directed Special Studies and Seminar**

Prerequisite(s): permission of the Department.

**BIOL 4901 [0.5 credit]****Directed Special Studies**

Independent or group study, open to third- and fourth-year students to explore a particular topic, in consultation with a Faculty supervisor. May include directed reading, written assignments, tutorials, laboratory or field work.

Prerequisite(s): permission of the Department. Students normally may not offer more than 1.0 credit of Directed Special Studies in their program.

**BIOL 4902 [0.5 credit]****Topics in Biology II**

Specific topics of current interest. Topics may vary from year to year.

Prerequisite(s): fourth-year standing in a Biology program or permission of the Department.

Lecture, seminars, or workshops three hours per week.

**BIOL 4905 [1.0 credit]****Honours Workshop**

Within the context of an active learning environment, students participate in a variety of activities which may include literature reviews and critiques, media releases and response papers, oral presentations, and posters. Projects are focused on an area of biological research of interest to the student.

Precludes additional credit for BIOL 4907 and BIOL 4908. Prerequisite(s): fourth-year standing in an Honours biology program and permission of the Department.

Workshops three hours per week.

**BIOL 4907 [1.0 credit]****Honours Essay and Research Proposal**

An independent critical review and research proposal, using library resources, under the direct supervision of a Faculty advisor. Evaluation is based on a written report and a poster presentation.

Precludes additional credit for BIOL 4905 and BIOL 4908. Prerequisite(s): fourth-year standing in an Honours Biology program and permission of the Department.

**BIOL 4908 [1.0 credit]****Honours Research Thesis**

An independent research project undertaken in the field and/or the laboratory, under the direct supervision of a faculty adviser. Evaluation is based on a written thesis and a poster presentation.

Precludes additional credit for BIOL 4905 and BIOL 4907. Prerequisite(s): fourth-year standing in an Honours biology program with a minimum CGPA of 8.0 in the major or permission of the Department.

**Summer session:** some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at [central.carleton.ca](http://central.carleton.ca)

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at [central.carleton.ca](http://central.carleton.ca)