

Biological Sciences

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Program Overview

The Biology programs educate students about diverse aspects of living organisms, ranging from microbes to human populations to complex ecosystems. Many of our graduates go on to graduate and professional studies in medicine, dentistry, veterinary medicine, the allied health sciences, forestry, wildlife biology, microbiology or biotechnology. A degree in biology also prepares students for direct employment in the biotechnology sector, environmental biology, or some allied health fields.

The Biology program's best attribute is its teachers. Our faculty members are dedicated to undergraduate teaching and enjoy helping students develop their knowledge and skills both in and out of the classroom.

The Department of Biological Sciences is well equipped for study and student research in zoology, botany, physiology, molecular biology and ecology. Students receive extensive instruction and hands-on experience in our modern laboratory facilities, and are encouraged in every way to develop their capacities for independent work. Bishop's University is located near a variety of habitats including bogs, lakes, rivers, mountains, marshes, hardwood forests and meadows. This variety means students can be hiking during one lab and canoeing the next. The rural setting of Bishop's combines the features of a biological field station with those of a well-equipped biology department, providing exceptional opportunities for field study and research in ecology and environmental biology. Those students interested in molecular biology and health sciences will benefit from the proximity of the Université de Sherbrooke. This French-language university provides an active nucleus of researchers in physiology, immunology, nuclear medicine, and microbiology. An ongoing collaboration between the Université de Sherbrooke and Bishop's provides our students (including unilingual Anglophones) with access to these researchers and their laboratories.

The Biology department offers both Bachelors of Science (B.Sc.) and Bachelors of Arts (B.A.) degrees. Students in either degree program choose between two concentrations: Health Science or Biodiversity and Ecology. Health Science is the best concentration for students interested in medical research, clinical medicine, or the allied health sciences (such as nursing or physiotherapy). Students interested in wildlife biology, plant science, and environmental biology choose the Biodiversity and Ecology concentration. Please note that the courses to be taken within each program are outlined in the nearby tables.

Please refer to the Natural Sciences Division page for information on *Divisional Requirements*.

Programs

All Biology programs include core Biology courses, courses related to the chosen concentration, and, in the case of B.Sc. programs, basic science courses. All Bachelor degrees require 120 credits; thus, each student takes elective courses in addition to those required for their specific program.

B.Sc. Biology Major (90 credits) MAJBIO

The B.Sc. programs are the best choice for students with a strong grounding in the core sciences (math, physics, and chemistry). Students graduating with a B.Sc. will be ready to enter graduate studies (M.Sc. or Ph.D) or professional schools (e.g. medicine, dentistry, physiotherapy, or veterinary medicine). See the nearby tables for the complete list of courses.

B.Sc. Biology Honours (102 credits)

HONBIO

Highly motivated students may choose to pursue an honours degree, which requires additional Biology courses and thus fewer electives (see nearby tables). To qualify, students must: (1) maintain a cumulative average of at least 75%; (2) receive a mark lower than 75% in no more than four credits (1 lecture and 1 laboratory course) in any 300 or 400-level Biology or Biochemistry course; and (3) obtain a mark of 75% or higher in each BIO 492 and BIO 493.

B.A. Biology Major (54 credits) MAJBIO

The B.A. Biology program is designed for students lacking a strong science background. This program has fewer required courses than the B.Sc. programs, so students may be able to complete the requirements of a second major within their 120-credit degree. It is thus ideal for students interested in pursuing a double major (such as Biology and Psychology, or Biology and Political Science), and provides a solid grounding in the biological sciences. The B.A. Biology degree provides adequate preparation for some, but not all, professional and graduate programs. Students are advised to consult officials of the specific post-graduate institution of interest.

Please see the nearby Tables for the complete list of courses required to complete this major.

Pre-Medicine Double Major MAJMED

Many of our students enrolled in the biology program are interested in going to medical school, and the BSc Biology (Health Sciences) program includes common prerequisites for application to medical schools in both Canada and the US. However, students should be aware that the entrance requirements can vary greatly between medical schools, and often change from year to year, therefore we recommend that students decide on which schools they are hoping to go to and then research what are the particular requirements of that school (the faculty can help you with this search). For those students unsure of where they would like to go and wishing to cover as wide a set of potential requirements as possible, BU also offers an inter-disciplinary Pre-Medicine double major, which specifically addresses these concerns. See the *Pre-Medicine Double Major* section for more details on how this program can be combined with a B.Sc. or B.A. Biology.

Biology Minor (24 credits) MINBIO

The biology minor consists of eight introductory courses in different areas of Biology. As illustrated in Table 2, seven of these courses are required and one is optional. This minor allows students majoring in a different field to obtain a perspective on modern biology.

Table 1: The Health Science Concentration

B.Sc. Biology (Health Sciences)*

1. Y1 Year

(All non-Quebec students; 30 cr)

BIO 196 Introduction to Cell & Molecular Biology

CHM 191 General Chemistry I

CHM 192 General Chemistry II

PHY 193 Physics for the Life Sciences I

PHY 194 Physics for the Life Sciences II

MAT 198 Calculus I for Life Sciences

MAT 199 Calculus II for Life Sciences

ENG 116

Effective Writing
(or other ENG)

Humanities option (CLA, ENG, HIS, REL, PHI or Lib. Arts)

Free elective: students may take any free elective or they may want to consider taking either *BIO 207 Introduction to Evolution and Ecology* or *BIO233 Human Anatomy*. Students who did not do well in BIO 196 should not take the above courses until their second year when they are better prepared.

2. Required Core Courses (21 cr)

BIO 201 Cellular and Molecular Biology

BIO 205 Diversity of Life 1

BIO 206 Diversity of Life 2

BIO 208 Genetics

BIO 336 Animal Physiology 1

CHM 111 Organic Chemistry

PHY 101 Statistical Methods

3. Required Concentration Courses (15 cr)

BCH 313 Metabolism

BIO 337 Animal Physiology 2

BIO 352 Microbiology

OR BCH 383 Molecular Biology

BCH 210 General Biochemistry

PSY 101 Introductory Psychology

4. Concentration Options (21 cr)

Select any 7 courses from the far right column. At least 5 of these courses must be from Biology and at least one of these 7 courses must be either BIO 394 Biology and Cancer, BIO 411 Health Science Seminar, or BIO 428 Advanced Physiology.

5. Science Options (6 cr)

Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by

science students (see individual course descriptions). For students interested in medicine, *PHY 206 Waves and Optics* and *CHM 211 Organic Chemistry II* may be good choices as they are pre-requisites for some medical schools.

6. Free Options (27 cr)

Choose 9 courses from any division to complete your 120-credit degree. These electives can be used to fulfill the requirements for a minor from a different department.

B.Sc. Biology Honours (Health Sciences)

In addition to requirements 1-5 above, students in the honours program must add the following 4 courses and reduce the free options by 12 credits (4 courses).

BIO 492 Honours Thesis I

BIO 493 Honours Thesis II

BIO 386 Scientific Writing

BIO 311 Quantitative Methods in Biology

B.A. Biology (Health Sciences)*

1. Y1 Year

(All non-Quebec students; 30 cr)

BIO 196 Introduction to Cell & Molecular Biology

ENG 116 Effective Writing
(or other ENG)

Humanities option (CLA, ENG, HIS, REL, PHI or Lib. Arts)

7 free options

2. Required Core Courses (15 cr)

BIO 201 Cellular & Molecular Biology

BIO 205 Diversity of Life 1

BIO 206 Diversity of Life 2

BIO 208 Genetics

PHY 101 Statistical Methods

3. Required Concentration Courses (12 cr)

BIO 233 Human Anatomy

PSY 101 Introductory Psychology

BIO336 Animal Physiology 1

BIO 337 Animal Physiology 2

4. Concentration Options (18 cr)

Select any 6 courses from the far right column, a minimum of 5 must be from Biology

5. Free Options (45 cr)

Choose 15 courses from any division to complete your 120-credit degree. Consider using these free options (along with the Y1 options, if applicable) to fulfill requirements for a second major.

Health Sciences Concentration Options*

BIO 207 Introduction to Evolution and Ecology

BIO 311 Quantitative Methods in Biology

BIO 315 Frontiers of Biology, From Past to Present

BIO 320 Programmed Cell Death

BIO 340 Comparative Anatomy

BIO 341 Population Genetics and Evolution

BIO 349 Medical and Forensic Entomology

BIO 359 Human Genetics

BIO 365 Developmental Biology

BIO 391 Experiential Learning in Health Sciences and Biochemistry

BIO 394 Biology of Cancer

BIO 411 Seminar in Health Sciences

BIO 428 Advanced Physiology

BIO 433 Advanced Exercise Phys

BCH 210 General Biochemistry

BCH 311 Proteins

BCH 312 Lipids and Membranes

BCH 381 Immunology

BCH 382 Environmental Biochemistry and Toxicology

BCH 383 Molecular Biology

BCH 422 Biotechnology

CHM 141 Analytical Chemistry

CHM 211 Organic Chemistry II

EXS 231 Nutrition for Sports and Exercise

EXS 317 Biomechanics of Human Movement

PBI 275 Health Psychology 1

PBI 288 Brain and Behavior 1

PBI 379 Neuropsychology

PBI 380 Psychopharmacology

PSY 213 Research Methods

PMA 360 Advanced Psychological Statistics

**Please note that many courses have associated labs, featuring the same course number and the BIL code, as indicated in the individual course descriptions. Lab credits do not count towards the total credit requirements of the program. The associated (co-requisite) lab must be completed to receive credit for the course.*

Table 2: The Biodiversity and Ecology Concentration**B.Sc. Biology
(Biodiversity and Ecology)*****1. Y1 Year****(All non-Quebec students; 30 cr)**

BIO196 Intro. to Cell &

Molecular Biology

CHM 191 General Chemistry I

CHM 192 General Chemistry II

PHY 193 Physics for the Life Sciences I

PHY 194 Physics for the Life Sciences II

MAT 198 Calculus I for Life Sciences

MAT 199 Calculus II for Life Sciences

ENG 116 Effective Writing (or other ENG)

Humanities option (CLA, ENG, HIS,REL,
PHI or Lib. Arts)

Free elective: students may take any free elective or, they may want to consider taking *BIO 207 Introduction to Evolution and Ecology*. Students who did not do well in BIO 196 should not take the above course until their second year when they are better prepared.

2. Required Core Courses (21 cr)

BIO 201 Cellular and Molecular Biology

BIO 205 Diversity of Life 1

BIO 206 Diversity of Life 2

BIO 208 Genetics

BIO 336 Animal Physiology 1

CHM 111 Organic Chemistry

PHY 101 Statistical Methods

3. Required Concentration Courses (15 cr)

BIO 207 Intro. to Evolution and Ecology

BIO 327 Advanced Ecology

BIO 338 Vertebrate Life 1 or

BIO 339: Vertebrate Life 2

BIO 329 Invertebrate Biology

ESG127 Introduction to Physical

Geography

4. Concentration Options (21 cr)

Select any 7 courses from the far right column, including a maximum of 2 non-BIO courses.

5. Science Options (6 cr)

Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for Science credit by science students (see individual course descriptions). Students wishing to continue to graduate school may want to consider taking MAT 209 Linear Algebra, or MAT 310 Ordinary Differential Equations, as these will better prepare them for more advanced statistical courses later in their careers.

6. Free Options (27 cr)

Choose 9 courses from any division to complete your 120-credit degree. These electives can be used to fulfill the requirements for a minor from a different department.

B.Sc. Biology Honours (Biodiversity and Ecology)

In addition to requirements 1-5 above, add the following courses and reduce the free options by 12 cr (4 courses).

BIO 492 Honours Thesis I

BIO 493 Honours Thesis 2

BIO 386 Scientific Writing

BIO 311 Quantitative Methods in
Biology**B.A. Biology****(Biodiversity and Ecology)*****1. Y1 Year****(All non-Quebec students; 30 cr)**

BIO 196 Introduction to Cell &

Molecular Biology

ENG 116 Effective Writing (or other
ENG)Humanities option (CLA, ENG, HIS,
REL, PHI or Lib. Arts)

7 free options

2. Required Core Courses (15 cr)

BIO 201 Cellular & molecular Biology

BIO 205 Diversity of Life 1

BIO 206 Diversity of Life 2

BIO 208 Genetics

PHY 101 Statistical Methods

3. Required Concentration Courses (12 cr)

BIO 207 Intro. to Evolution and Ecology

BIO 338 Vertebrate Life 1 or

BIO 339 Vertebrate Life 2

BIO 329 Invertebrate Biology

ESG 127 Introduction to Physical

Geography

4. Concentration Options (18 cr)

Select any 6 courses from the far right column, a minimum of 5 must be from Biology.

5. Free Options (45 cr)

Choose 15 courses from any division to complete your 120-credit degree. Consider using these free options (along with the Y1 options, if applicable) to fulfill requirements for a second major.

Biodiversity and Ecology**Concentration Options**

BIO 311 Quantitative Methods in Biology

BIO 315 Frontiers of Biology,
From Past to Present

BIO 327 Advanced Ecology

BIO 329 Invertebrate Biology

BIO 331 Freshwater Biology

BIO 332 Vertebrate Zoology

BIO 337 Animal Physiology 2

BIO 341 Population Genetics and
Evolution

BIO 334 Epidemiology

BIO 338 Vertebrate Life 1

BIO 339 Vertebrate Life 2

BIO 340 Comparative Anatomy

BIO 349 Medical and Forensic
Entomology

BIO 352 Microbiology

BIO 354 Insect Biodiversity

BIO 358 Animal Behaviour

BIO 386 Science Writing

BIO 392 Experiential Learning in
Biodiversity & EcologyBIO 412 Seminars in Biodiversity &
Ecology

BCH 313 Metabolism

ESG 262 Introduction to GIS

ESG 250 Geomorphology

ENV 241 Environmental Chemistry I

ENV 242 Environmental Chemistry II

ENV 337 Economics of the Environment

ENV 375 Environmental Physics

ENV 475 Ecological Economics

Minor in Biology (24 credits)

BIO196 Intro. to Cell &

Molecular Biology

BIO 201 Cellular & Molecular Biology

BIO 205 Diversity of Life 1

BIO 206 Diversity of Life 2

BIO 207 Intro. to Evolution and Ecology

BIO 208 Genetics

Any 2 additional Biology courses

**Please note that many courses have associated labs, featuring the same course number and the BIL code, as indicated in the individual course descriptions. Lab credits do not count towards the total credit requirements of the program. The associated (co-requisite) lab must be completed to receive credit for the course.*

Note: A course can only count under one category. For instance, if you took BIO 338 as a required concentration course, it cannot be counted as one of your concentration options.

List of Courses

PLEASE NOTE: The following list of courses represents those courses which are normally offered by the Department of Biological Sciences. However, some courses alternate and thus are only available every second year. Courses offered on an occasional basis are indicated with an asterisk (). Students should plan their schedules in advance, in consultation with their Departmental Chair, to ensure that they register for all of the courses required for graduation.*

BIO 111 Organic Gardening 3-3-0

This course is an introduction to organic and environment-friendly gardening, combining lectures and a hands-on-practicum. Principles of companionship, growth, water and mineral balance will be discussed. Students will learn how to recognize and treat diseases, pests or common physiological disorders with environmentally natural techniques. At the end of this course, students should be able to set-up and run a garden using environment-friendly techniques and know how to harvest, handle and store crops. Depending on the interests of the group, the course will either cover transformation strategies for year-long storage of vegetables grown in the summer (canning, freezing, fermentation, drying...), or make an introduction to entrepreneurship in organic farming (based on the instructor's own experience). In addition, several visits will be organized to locally run organic farms to present various models of environment-friendly productions of veggies, fruits and herbs.

Note: This course is open to the general public and may be taken by non-DNS students for science credit. However, students in any of the science majors may only take this course as a free elective, and may not count this course for science credit. It is offered in the spring semester.

BIO 131 The Human Body in Health and Disease 3-3-0

An introduction to human anatomy and physiology. This course will employ problem-based learning, virtual experiments, and traditional lectures to explain the relationship between the structure of the human body and its functions. These concepts will then be applied to the study of representative human diseases. This course is designed for students with minimal biology backgrounds, including arts students, teachers, coaches, and home-care workers. Students will acquire a working knowledge of human biology and the ability to communicate this knowledge to others.

Prerequisites: Secondary school Biology and/or Chemistry recommended

Note: This course cannot be taken for credit by students in Biology or Biochemistry or by students with credit for BIO 233

BIO 194 General Biology for the Social and Human Sciences 3-3-0

This course provides an introduction to biology for students without a strong science background. Topics include: Scientific method, chemistry of life, cell structure, cell metabolism, photosynthesis, origin of life, evolution, genetics, reproduction, diversity of life, ecology, and ecosystems. This course cannot be taken for credit by students in a B.Sc. program of B.A. Biology. It is not a sufficient prerequisite for more advanced Biology courses.

This course cannot be taken for credit by anyone who already has credit for collegial Biology NYA, BIO 191, BIO 193, BIO 196 or BIO 197.

BIO 196 Introduction to Cell & Molecular Biology 3-3-0

Topics covered include: chemistry of life; structure and function of biomolecules; structure and organization of cells; structure and function of organelles, genetic replication and expression; gene mutation; cell signaling; regulation of the cell cycle. This course is intended for B.Sc. students and B.A. (Biology) students; other students are encouraged to take BIO 194.

Prerequisite: High School Biology and Chemistry

This course cannot be taken for credit by anyone who already has credit for collegial General Biology 2/00XU, BIO 191, BIO 193 or BIO 194.

Corequisite: BIL 196

BIL 196 Introduction to Cellular and Molecular Biology Laboratory 1-0-3

Practical exercises in microscopy, molecular and cellular biology, and histology.

Prerequisites: High School Biology and Chemistry; Co-requisite: BIO 196

BIO 201 Cellular and Molecular Biology 3-3-0

Topics in modern cell biology. Examines aspects of eukaryotic cell structure and function. Includes, but not restricted to, areas such as intracellular signaling, cell cycling and cancer, cell-matrix interactions, endo/exocytosis, protein targeting and organelle biogenesis.

Prerequisites: BIO 196 or collegial general Biology 2/00XU or BIO 194 with a mark of 75% or better

This course may not be taken for credit by anyone who already has credit for Biology 110.

BIO 205 Diversity of Life I 3-3-0

This course offers a thorough exploration of one branch of the tree of life, that occupied by multicellular animals. The course complements Diversity of Life II, a winter-term course with a focus on prokaryotic and non-animal eukaryotic life. The material in both courses is organized according to a modern phylogenetic framework. In this course students will learn about phylogenetic hypotheses and evidence, and they will study how classifications are created, tested, and, where necessary, rejected. Focusing on animals, we will discuss many of the morphological and physiological adaptations that have arisen. The evolutionary implications of some features, such as bilateral symmetry and the notochord, will be discussed more thoroughly. Recent advances as well as current contentious issues in animal classification will also be examined.

Prerequisite: BIO 194 or BIO 196; Co-requisite: BIL 205

Students with credit for BIO 115 cannot also receive credit for BIO 205.

BIL 205 Diversity of Life I Laboratory 1-0-3

The classification, identification, morphology and biology of the animals considered in BIO 205.

Co-requisite: BIO 205

Students with credit for BIL 115 cannot also receive credit for BIL 205.

BIO 206 Diversity of Life II 3-3-0

Like its companion course BIO 205, this course explores the tree of life, but from a less animal-centric view. We study the prokaryotes at the root of the tree, responsible for more than half of the earth's biomass. Next, we examine the branch that contains all fungi (and lichens). The various protists and those algae that are not related to green plants form other branches, which we will also explore. Finally, we study in more detail the largest group of eukaryotes by biomass, the green plants. The material in this course (and in BIO 205) is organized according to a modern phylogenetic framework. The focus will be on diversity, function and ecological importance. In the case of the green plants, we look at the reasons for the tremendous ecological success of this form of life. We examine photosynthesis, transport, reproduction and life cycles, and evolution, empathizing ecological relevance.

Prerequisite: BIO 194 or BIO 205

BIO 207 Introduction to Evolution and Ecology 3-3-0

This course will start by looking at the development of modern evolutionary theory before exploring natural selection and speciation. This course will then explore some of the basic principles of ecology, including species interactions such as predation and competition, and how these interactions help structure the complex web of life that helps form ecological communities and ecosystems. Although intended for Biology majors, students from other programs may also take this course with the instructor's permission.

This course cannot be taken for credit by anyone who already has credit for BIO 197.

BIO 208 Genetics 3-3-0

An introduction to the study of biologically inherited traits from three perspectives. (i) Mendelian Genetics: the rules of genetic transmission and heredity. (ii) Molecular Genetics: the biochemical and chromosomal basis of heredity. (iii) Population & Evolutionary Genetics: the variation in genes amongst individuals and populations, heritability, and changes in genes over time.

Prerequisite: BIO 194 or BIO 196; Co-requisite: BIL 208

Students with credit for BIO 118 cannot also receive credit for BIO 208.

BIL 208 Genetics Laboratory 1-0-3

Experiments in genetics designed to complement topics discussed in BIO 208.

Co-requisite: BIO 208

BIO 211 Sustainable Organic Agriculture 3-3-0

The objective of this course is to introduce students to the concepts and techniques of organic gardening through an integrated and sustainable approach. Subjects covered will include, applied botany, basic soil chemistry, weed control, crop rotation, tillage, ecologically responsible use of fertilizers, and drainage and irrigation practices. The course includes lecture classes as well as practical hands-on activities in biology laboratory JOH 320, JOH greenhouse and the Biology outdoor garden, where students will be expected to apply some of the techniques discussed in class to real life situations.

Pre or Co requisites: BIO205 and BIO206 or with permission of the instructor if the student can demonstrate a suitable background knowledge of the necessary material. Co-requisite BIL211. This course may not be taken for credit by students who have already completed BIL111.

- BIL 211 Sustainable Organic Agriculture Lab 1-0-3**
This lab course requires students to work in small teams on a variety of projects around campus. Central to each project will be the integration of principles learned in the organic agriculture lecture. Examples of such projects might include; the development of an ecologically friendly butterfly garden; integrated plantings to minimize crop damage; design and installation of a bioswale system; or monitoring and control of entomological pests on campus. Students should be aware that most of these projects will involve outdoor field work which includes working in all weather conditions, getting bitten or stung by insects, and in general getting dirty.
Co-requisite: BIO 208
- BIO 233 Human Anatomy 3-3-0**
The anatomy of all of the major body systems will be discussed in the context of human health and disease. This course is designed for students interested in the biomedical sciences or health education. Students will develop their understanding of human anatomy and will acquire the ability to communicate scientific concepts to their patients or students.
Prerequisite or Corequisite: BIO 196 or EXS 127
This course cannot be taken for credit by anyone who already has credit for BIO131, BIO 132, or BIO 133
- BIO 311 Quantitative Methods in Biology 3-3-0**
The main objective of this course is to teach how to use quantitative methods as a tool to answer practical problems in biological sciences. This course focuses on real life situations often encountered by scientists such as how to critically review studies, study design, and statistical output. This course will also cover the statistical and data management methods most often used in biological sciences.
Prerequisite: BIO208 and PHY 101
- BIO 315 Frontiers of Biology, From Past to Present 3-3-0**
This course is for upper year biology students who already have a good understanding of complex concepts like human DNA sequencing, genomics, cell biology, and human anatomy and physiology. Topics covered include the history of genetics and human evolution, cell theory, chromosomes, mitosis and meiosis, human fertilization and heredity, recent advances in pharmacogenomics, genetic selection, and the CRISPR technology for DNA editing. The goal of this course is to broaden student's understanding on the development and acceptance of such discoveries and to ultimately understand that what they learnt in their first 2 or 3 years in biology is knowledge built from several non-linear steps that will likely go on evolving and developing in future years.
Prerequisites: BIO 205 and BIO 208
Students with credit for BIO 319 cannot receive credit for BIO 315.
- BIO 320 Programmed Cell Death 3-3-0**
Programmed cell death, also called apoptosis, is a normal physiological process that takes place in every type of cell in the animal kingdom. It plays a critical role in embryo development, in selective processes (immune system), in degenerative diseases and in cancer. Since the early 90's, programed cell death is one of the fastest growing subject of research, with almost 15000 scientific publications in 2004. In this course, we will explore normal and impaired mechanisms involved in cell death, through examples taken in human medicine or in invertebrates' development.
Prerequisite: BIO 201
- BIO 327 Advanced Ecology 3-3-0**
Ecology is about finding the best data/modelling to test your theories and hypotheses. Great ideas, hiking boots and computers are all that are needed. This ecology course focuses on understanding the relationships between organisms and the strategies they use to survive, reproduce, and interact with their environment. This course will expand on the fundamental theories of ecology seen in BIO 207 with the application to real life data and analysis. *Prerequisite: BIO 207*
Students with credit for BIO 217 cannot receive credit for BIO 327.
- BIO 329 Invertebrate Biology 3-3-0**
Morphology, physiology, embryology, evolution and classification of invertebrate animals.
Prerequisite: BIO 205; Co-requisite: BIL 329
Students with credit for BIO 248 cannot also receive credit for BIO 329.
- BIL 329 Invertebrate Biology Laboratory 1-0-3**
The classification, identification, morphology and biology of the animals considered in BIO 329.
Co-requisite: BIO 329
Students with credit for BIL 248 cannot also receive credit for BIL 329.
- BIO 331* Freshwater Biology 3-3-0**
This course will expose students to the biological importance and diversity of freshwater systems. Class material will look at both the biotic and abiotic components of aquatic systems as well as their interactions.
Prerequisite or Co-requisite: BIO 205; BIO 207; Co-requisite: BIL 331
- BIL 331* Freshwater Biology Lab 1-3-0**
The lab section will focus on the different techniques necessary for sampling both lentic and lotic systems. Emphasis will be placed on practical first-hand experience using the appropriate equipment in the field. The process of data collection will culminate in the students performing a mini-research project on a local aquatic system of their choice and presenting these data to their peers.
Prerequisite or Co-requisite: BIO 205; BIO 207; Co-requisite: BIO 331
- BIO 334* Epidemiology 3-3-0**
Epidemiology is the study of the distribution and determinants of diseases and health conditions among populations and the application of that study to control health problems. Concepts learned in this course will be applied to current health issues from different perspectives, such as pharma-economy, health care management, disease avoidance and food production.
Prerequisite: BIO 201 and BIO 208
- BIO 336 Animal Physiology I 3-3-0**
Basic mechanisms of homeostatic regulation. Topics include: Cell physiology, Nervous system, Muscular system, and the Cardiovascular system.
Prerequisite: BIO 201
Students who have received credit for BIO 226 cannot also receive credit for BIO 336.
- BIO 337 Animal Physiology II 3-3-0**
Mechanisms of functional operation of animal organisms. Topics include: renal, respiratory, gastrointestinal, and reproductive function.
Prerequisite: BIO 208 and BIO 336; Co-requisite: BIL 337
Students who have received credit for BIO 228 cannot also receive credit for BIO 337.
- BIL 337 Animal Physiology II Laboratory 1-0-3**
Experiments dealing with different aspects of animal physiology. Some experiments will be performed using computer simulations.
Co-requisite: BIO 337
Students who have received credit for BIL 228 cannot also receive credit for BIL 337.
- BIO 338 Vertebrate Life I: An Introduction to Ichthyology and Herpetology 3-3-0**
This course is the first of two exploring those animals with a cartilaginous or bony backbone, the vertebrates. Given their great diversity, two courses have been devoted to this group, Vertebrate Life 1 & 2; this is the first of those courses. Vertebrate Life 1 will focus on the fishes, amphibians, and reptiles and is divided into two sections. The first section will explore the evolution of the earliest vertebrates and the myriad of types that we generally refer to as fishes. Part two of the course will look at the colonization of land by the first tetrapods and the rise of the amniotes and will explore the extant groups of amphibians and reptiles. Students may not receive credit for this courses if they have already taken BIO 332 and BIO 367
Prerequisites: BIO 205 and BIO 207
- BIO 339 Vertebrate Life II: An Introduction to Ornithology and Mammalogy 3-3-0**
This course is the second of the series focusing on the evolutionary history and diversity of the vertebrates and will focus on the mammals and birds. From the tiniest hummingbird to the mightiest whale, these two vertebrate groups represent separate evolutionary branches from within the amniote family tree. The course will start by looking at the ancestors of each group, before exploring their evolutionary diversification, and how these distantly related groups have solved similar evolutionary problems. Vertebrate Zoology II may be taken without previously taking Vertebrate Zoology I.
Co-requisite: BIL 339
Prerequisites: BIO 205 and BIO 207
Students may not receive credit for this course if they have already taken BIO 332
- BIL 339 Vertebrate Life II Lab 1-0-3**
This is the co-requisite lab to the BIO 339 Vertebrate Life II. This course will help students develop basic skills in the identification of most of the common vertebrates in the region. Although focusing primarily on the subject matter of the co-requisite lecture, BIO 339 birds and mammals, all vertebrate groups will be explored including fishes, amphibians, and reptiles.
Co-requisite: BIO 339
Prerequisites: BIO 205 and BIO 207
Students may not receive credit for this course if they have already taken BIL 332

- BIO 340* Comparative Vertebrate Anatomy 3-3-0**
This course will use a comparative approach to help students understand vertebrate anatomy. Students will explore the evolution of major organ systems within the vertebrates, using both dissection and preserved material. Students should be prepared to both take lecture notes and dissect specimens every class.
Prerequisites: BIO 205
- BIO 341 Population Genetics and Evolution 3-3-0**
Understanding the processes by which selection and genetic variation allows species to adapt and evolve is an important aspect of biology. This course uses a wide spectrum of examples from animal and plant populations to outline the general principles in population and quantitative genetics that will then be applied to important issues in health sciences.
Prerequisite: BIO 208
- BIO 349 Medical and Forensic Entomology 3-3-0**
As one of the most important group of disease vectors, insects and other arthropods are involved in the transmission of numerous pathogens causing diseases such as the plague, malaria, West Nile fever, scabies, and Lyme disease. This course will introduce students to some of the basic concepts of medical entomology with a focus on selected diseases. Information on the life cycles of insect vectors and the pathogens they carry is presented, as well as symptoms, treatment and geographical distribution of selected arthropod-borne diseases. The relevance of entomological evidence in criminal investigations (such as the use of insects to determine post-mortem interval) is also discussed.
Prerequisite: BIO 205
- BIO 352 Microbiology 1-0-3**
An introduction to prokaryotic microorganisms, eukaryotic microorganisms, and viruses; their ecology, growth characteristics, and host interactions. Examination of the environmental roles of microbes as well as their impact on the human world.
Prerequisite: BIO 201 and BIO 208; Co-requisite: BIL 352
- BIL 352 Microbiology Laboratory 1-0-3**
An introduction to common microbiological techniques used in medical, biological and biochemical research, including techniques in growth, staining and identification of bacteria and viruses. As well, the diversity of physiological and metabolic requirements of bacteria will be examined.
Co-requisite: BIO 352
- BIO 354 Insect Biodiversity 3-3-0**
The main goal of this course is to teach the students how to collect, preserve and identify insects, especially those found in eastern North America. In addition to using material housed in the Bishop's insect collection, material collected in the field by each student will be prepared in a fashion that will make the specimens museum worthy. Through the collecting and identification process, students will learn about insect taxonomy but they will also learn about where different taxa can be found and what their general ecological requirements are. Once they have completed the course, students should be able to identify most commonly encountered insects at least to the family level and recognize those that are beneficial or potentially harmful.
Prerequisite: BIO 205
- BIO 358 Animal Behaviour 3-3-0**
The study of animal behaviour represents the oldest known form of biological study. Even from our earliest beginnings, humans had an intense interest in understanding how animals behave. This interest is still evident from our almost instinctive need to share our homes with various pets. This course will build on this most basic need to watch and understand animal behaviour, but will do so from a more scientific approach.
Prerequisite: BIO 205, BIO 207
- BIO 359 Human Genetics 3-3-0**
Cytogenetics, biochemical genetics, Mendelian genetics, molecular genetics and quantitative genetics of humans; chromosome mapping; genetics and medicine.
Prerequisite: BIO 208
- BIO 365 Developmental Biology 3-3-0**
Examination of the molecular events involved in the development of vertebrates, invertebrates and plants, emphasizing common strategies used in these three systems. Topics will include establishment of body axes, origin of germ layers, and segmental pattern formation. The role of developmental genes, regulatory gene families, and maternal effect genes will be emphasized. Morphogenesis and early cell differentiation will also be studied.
Prerequisite: BIO 208 and BIO 201
- BIO 386 Scientific Writing 3-3-0**
Lectures will introduce the scientific method and train students to critically read the scientific literature. Detailed examples of a written paper will then follow with step-by-step instructions. Data analysis, word processing and citation methods will be reviewed. In addition to written manuscripts, poster and oral presentations will be discussed.
Prerequisite: This course is normally open to Y3 or Y4 students by permission of departmental chair or instructor.
Students with credit for BIO 272 cannot also receive credit for BIO 386.
- BIO 391 Experiential Learning in Health Sciences and Biochemistry 3-3-0**
Students in the Health Science or Biochemistry program may receive credit for working under the tutelage of a mentor in a field directly related to their area of study. Students must secure both an internal supervisor (a fulltime faculty member) and a suitable mentor (i.e. external supervisor who will supervise the day to day activities of the student). Students must be actively involved in the daily work and should not be acting as menial labor.
Assessment of the student will be based largely on a mark assigned by the mentor directly responsible for the student and the submission of a journal outlining the daily objectives and actual work itself. Projects may be intensive in nature (i.e. 3 weeks during the summer), or may be more drawn out (i.e. 6-8 hours every week during the semester).
This course is only eligible to students in good standing and if available positions are available. Students may not work for salary and may not work concurrently in an area directly related to their honors project.
Note: Students may only take one experiential learning course for credit (i.e. BIO 391 or BIO 392 or ELP 300).
Coordinator: Professor Savage
- BIO 392 Experiential Learning in Biodiversity & Ecology 3-3-0**
Students in the Biodiversity & Ecology program may receive credit for working under the tutelage of a mentor in a field directly related to their area of study. Students must secure both an internal supervisor (a fulltime faculty member) and a suitable mentor (i.e. external supervisor who will supervise the day to day activities of the student). / Students must be actively involved in the daily work and should not be acting as menial labor.
Assessment of the student will be based largely on a mark assigned by the mentor directly responsible for the student and the submission of a journal outlining the daily objectives and actual work itself. Projects may be intensive in nature (i.e. 3 weeks during the summer), or may be more drawn out (i.e. 6-8 hours every week during the semester).
This course is only eligible to students in good standing and if available positions are available. Students may not work for salary and may not work concurrently in an area directly related to their honors project.
Note: Students may only take one experiential learning course for credit (i.e. BIO 391, or BIO 392 or ELP 300).
Coordinator: Professor Savage
- BIO 394 Biology of Cancer 3-3-0**
This course will review the broad subject of cancer development and treatment. In particular it will focus on taking concepts seen in cell biology and applying them to cancer cells. Among the topics reviewed will be: cancer types and staging, mutation rates and environmental contributions to genetic changes, oncogenes and tumor suppressors, cell proliferation/death balance, modification of cancer cells phenotypes and metastases formation, role of the immune system in the prevention of cancer spreading, strategies of cure, and a review of the body's physiological responses to several forms of cancer.
Prerequisites: BIO 336 AND BIO 201
Offered in odd-numbered winters
Students with credit for BIO 224 cannot receive credit for BIO 394
- BIO 411 Seminars in Health Sciences 3-3-0**
An advanced course discussing current topics in the Health Sciences. Students will be expected to critically evaluate recent scientific literature, prepare and deliver oral and written presentations, participate in discussions, and analyze research questions.
Pre-requisites: BIO 208 AND BIO 336
Restricted to students in year 3 or 4 (i.e. with less than 60 credits remaining of a B.Sc. Biology degree)
- BIO 412* Seminars in Biodiversity & Ecology 3-3-0**
This course will discuss recent developments in specific areas of ecology, conservation, and/or zoology. The course content will vary from year to year, depending on the instructor's area of expertise and the students' interests.
Prerequisite: BIO 205, BIO 207
Students with credit for BIO 362 cannot also receive credit for BIO 412.

BIO 421 Independent Studies in Biology I

3-1-3

This course is intended for final-year students who wish to pursue in-depth study of a particular area of biology or who have a special need for a biology course that would otherwise not be available during their final semester of course work. This course can only be done in close collaboration with a faculty advisor from within the Department of Biological Sciences, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by a committee of professors from within the Department of Biological Sciences.

Pre-requisite: Permission of the committee

Students with credit for BIO 371 cannot also receive credit for BIO 421.

Coordinator: Professor Chamoux

BIO 422 Independent Studies in Biology II

3-1-3

This course represents an additional semester of independent work, either a continuation of or a separate course from BIO 421, meant for final-year students who wish to pursue in-depth study of a particular area of biology or who have a special need for a biology course that would otherwise not be available during their final semester of course work. This course can only be done in close collaboration with a faculty advisor from within the Department of Biological Sciences, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by a committee of professors from within the Department of Biological Sciences.

Pre-requisite: Permission of the committee

Students with credit for BIO 372 cannot also receive credit for BIO 422.

Coordinator: Professor Chamoux

BIO 428 Advanced Physiology

3-3-0

This course will examine how animals adapt to environmental stresses such as extremes of temperature of altitude, hypoxia, water limitation and dietary changes. Short-term (acute), medium-term (acclimatory) and chronic (evolutionary) adaptations will be discussed.

Pre-requisite: BIO 336; Pre-or Co-requisite: BIO 337

Offered in even-numbered winters

Students with credit for BIO 328 cannot also receive credit for BIO 428.

BIO 433 Advanced Exercise Science

3-3-0

This course examines selected topics in Exercise Physiology. Through traditional lectures, directed readings, seminars, and case studies, students will study short-term and long-term adaptations to exercise. We will also examine the scientific principles underlying sports-related topics such as optimizing exercise performance, injuries, and injury repair.

Prerequisite: BIO 336 or EXS 327

Students with credit for BIO 333 cannot also receive credit for BIO 433.

Note: See Exercise Science 433. Students may not take this course for credit if they have received credit for EXS 433.

BIO 492 Honours Research Project I

3-1-6

An introduction to the planning, execution and reporting of biological research offered to students matching eligibility criteria. Each student is required to choose a research problem and, in consultation with a departmentally approved supervisor, draw up a formal research proposal of work to be undertaken. The final mark in this course will be based on the research proposal, preliminary research completed on the stated project, and presentation of a poster during the final week of classes. Satisfactory completion of BIO 492 with a minimum mark of 75%, with a minimal score of 70% in each graded component, is required for enrolment in BIO 493.

Prerequisite: Permission of committee

Co-requisite or prerequisite: BIO 386

Students with credit for BIO 421 cannot also receive credit for BIO 492.

BIO 493 Honours Research Project II

3-1-6

A continuation of BIO 492 offered to students matching eligibility criteria. The student will complete all research as outlined in the research proposal. The final mark in this course will be based on the quality and amount of research completed, presentation of a departmental seminar during the final week of classes, open to the public, based on research findings, and submission of a final written honours thesis. Enrolment in BIO 493 is conditional upon completing BIO 492 with a minimum mark of 75%. Satisfactory component, is required to complete the Honours program.

Prerequisite: Permission of committee

Students with credit for BIO 422 cannot also receive credit for BIO 493.

Chemistry

Faculty

Mihai Scarlete,

Ph.D. (McGill), Ph.D. (Politehina Inst., Bucharest); Professor

Dale Wood,

B.Sc., Ph.D. (UNB); Associate Professor

Program Overview

The Chemistry Department offers three distinct programs — Chemistry Honours, Chemistry Major, and Chemistry Minor. All of our programs provide students with a balanced, rich, and practical education in all sub-disciplines of Chemistry (Analytical, Biochemical, Inorganic, Organic, and Physical) and students graduating with a Chemistry degree from Bishop's University have had an excellent record of being admitted to graduate schools and professional programs (Medicine, Dentistry, Pharmacy, Education, etc.) or in finding employment in their field.

Class sizes in chemistry courses are small, which promotes close personal interaction between members of the faculty and students. The faculty are also directly involved in all undergraduate laboratories, which enhances personal contact and results in a friendly and very productive learning in experimental chemistry.

The Chemistry Department has an excellent set of modern instruments, such as a 400 MHz NMR and a GC/MS, which are used by undergraduates in their laboratory courses and in research projects. This is in contrast to most universities where many instruments are reserved for graduate students. Hands-on, extensive training on this modern instrumentation and equipment greatly benefits our students and ensures that they are very well prepared for graduate studies or future employment.

Undergraduate Programs

It is strongly recommended that students enrolled in Department of Chemistry programs follow the order of courses outlined in the tables below. Some Chemistry courses are offered on two-year rotations, so failure to follow the suggested course sequence may result in students not being able to fulfill their degree requirements in the normal time frame.

Table 1. First year of study in the 4-year Chemistry Honours and Major programs

Fall Semester

CHM191 and CHL191
BIO196 and BIL196
PHY191 and PHL191
MAT191
ELA116

Winter Semester

CHM192 and CHL192
PHY192 and PHL192
MAT192
Humanities Option
Humanities Option