

# BIOLOGICAL SCIENCES (BIOL)

## **BIOL 1000 Biology: Foundations of Life 3 cr**

A course in unifying principles of biology including cell biology, bioenergetics, cell division, genetics and evolution. May not be used for credit in a Major or Honours program in the Biological Sciences. May not be held with BIOL 1001, BIOL 1020, or BIOL 1021.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: One of Grade 12 or 40S Mathematics course (50%), MATH 1018, or MSKL 0100.

**Equiv To:** BIOL 1001

**Mutually Exclusive:** BIOL 1020, BIOL 1021

**Attributes:** Science, Recommended Intro Courses

## **BIOL 1010 Biology: Biological Diversity and Interaction 3 cr**

An introduction to biological diversity including prokaryotes, protists, fungi, plants and animals; the form and function of plants and animals and basic concepts of ecology. May not be used for credit in a Major or Honours program in the Biological Sciences. May not be held with BIOL 1011, BIOL 1030, or BIOL 1031.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: One of Grade 12 or 40S Mathematics course (50%), MATH 1018, or MSKL 0100.

**Equiv To:** BIOL 1011

**Mutually Exclusive:** BIOL 1030, BIOL 1031

**Attributes:** Science, Recommended Intro Courses

## **BIOL 1020 Biology 1: Principles and Themes 3 cr**

(Lab required) A laboratory-based course in unifying principles of biology including cell biology, bioenergetics, cell division, genetics and evolution. This course is intended for Major and Honours students in the Biological Sciences. May not be held with BIOL 1021, BIOL 1000, BIOL 1001, or BIOE 2590. Students who complete BIOL 1000 or BIOL 1001 as the prerequisite for BIOL 1020 will not be allowed to use either BIOL 1000 or BIOL 1001, and BIOL 1020 towards their degree program as the courses may not be held for credit with one another.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: [Biology 40S (50%) and (one of: Mathematics 40S (50%), MATH 1018, or MSKL 0100) and (one of: Chemistry 40S (50%), CHEM 1018, CSKL 0100, Physics 40S (50%), PHYS 1018, or PSKL 0100)] or [BIOL 1000 or BIOL 1001].

**Equiv To:** BIOL 1021

**Mutually Exclusive:** BIOE 2590, BIOL 1000, BIOL 1001

**Attributes:** Science

## **BIOL 1030 Biology 2: Biological Diversity, Function and Interactions 3 cr**

(Lab Required) A laboratory-based course introducing biological diversity including prokaryotes, protists, fungi, plants and animals; the form and function of plants and animals and basic concepts of ecology. This course is intended for major and honours students in the Biological Sciences. Not to be held with BIOL 1031, BIOL 1010 or BIOL 1011, BIOE 2590. NOTE: BIOL 1030 is a prerequisite to further courses in Microbiology and to most courses in Biological Sciences. It is also intended for students proceeding to Agricultural and Food Sciences, Dentistry, Human Ecology, Medicine, Optometry, Pharmacy, Veterinary Science, Physical Education and Science.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 1020 or BIOL 1021.

**Equiv To:** BIOL 1031

**Mutually Exclusive:** BIOE 2590, BIOL 1010, BIOL 1011

**Attributes:** Science

## **BIOL 1300 Economic Plants 3 cr**

A survey of economically important plants and their products. The history of plant use, plants in folklore and medicine, fermentation and viticulture, domestication of plants, and forestry are the major topics covered. Chemical, structural, and nutritional aspects of plant products are also discussed.

**Equiv To:** BOTN 1010

**Attributes:** Science, Recommended Intro Courses

## **BIOL 1340 The State of the Earth's Environment: Contemporary Issues 3 cr**

A presentation of contemporary environmental issues focusing on the scientific basis of problems caused by the growth of human population, use and depletion of resources, pollution, and damage to the environment. The current state of our knowledge bases will be discussed, along with improvements in them that may be necessary. The course will consider needs for action, priorities, and opportunities. May not be used to meet a program requirement of an Honours or Major program in the Biological Sciences. Not to be held with ENVR 1000.

**Mutually Exclusive:** ENVR 1000

**Attributes:** Science, Recommended Intro Courses

## **BIOL 1410 Anatomy of the Human Body 3 cr**

(Lab Required) Microanatomy and gross anatomy discussed including changes occurring from conception to old age. Although this course may be used as an elective in an Arts or Science program, it may not be used to meet a program requirement of an Honours or Major program in the Biological Sciences. May not be held with BIOL 1411. No prerequisite. High school Biology strongly recommended.

**Equiv To:** BIOL 1411, ZOO 1320

**Attributes:** Science, Recommended Intro Courses

## **BIOL 1412 Physiology of the Human Body 3 cr**

(Lab Required) Function of all systems discussed with homeostatic regulatory mechanisms as foundation themes. Although this course may be used as an elective in an Arts or Science program, it may not be used to meet a program requirement of an Honours or Major program in the Biological Sciences. Not available to students who have previously obtained credit in, or are currently registered in both of BIOL 2410 (BIOL 2411) and BIOL 2420 (BIOL 2421) or BIOL 1413. This prerequisite is waived for students in the Baccalaureate Program for Registered Nurses.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 1410 or BIOL 1411; or one of BIOL 1030, BIOL 1031.

**Equiv To:** BIOL 1413, ZOO 1330

**Mutually Exclusive:** BIOL 2410, BIOL 2411, ZOO 2530, ZOO 2531

**Attributes:** Science, Recommended Intro Courses

## **BIOL 2200 The Invertebrates 3 cr**

(Lab Required) Biology and phylogeny of invertebrates. Emphasis on common taxa and on those groups of particular phylogenetic significance. Not to be held with BIOL 2201.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031.

**Equiv To:** BIOL 2201, ZOO 2600, ZOO 2601

**Attributes:** Science

## **BIOL 2210 The Chordates 3 cr**

(Lab Required) A study of the origin, evolutionary history and structure of the major groups of Chordates. Provides the foundation for more specialized courses such as Biology of Fishes, Ornithology, and Systematics and Biogeography of Fishes. Not to be held with BIOL 2231.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031.

**Mutually Exclusive:** BIOL 2231, ZOO 2320, ZOO 2501

**Attributes:** Science

**BIOL 2240 The Non-Flowering Plants 3 cr**

(Lab Required) An introduction to the mosses and liverworts, ferns and their allies, and conifers, specifically treating their structure, reproduction, identification and ecological significance.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031.

**Equiv To:** BOTN 2110

**Attributes:** Science

**BIOL 2242 The Flowering Plants 3 cr**

(Lab Required) A study of the structure and function of the flowering plants. Lecture topics are supplemented by laboratory exercises that focus on the anatomy and morphology of roots, stems, leaves and reproductive organs.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 1030 or BIOL 1031.

**Equiv To:** BOTN 2010

**Attributes:** Science

**BIOL 2260 Biology of Fungi and Lichens 3 cr**

(Lab Required) An introduction to the fungi, both free living and lichenized, with emphasis on the major taxonomic groupings, their organization and structure, their life histories, identification and general economic significance. May not be held with BIOL 2261.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 1030 or BIOL 1031.

**Equiv To:** BIOL 2261, BOTN 2210

**Attributes:** Science

**BIOL 2262 Biology of Algae 3 cr**

(Lab Required) (Formerly BIOL 3260) Lectures and laboratories dealing with the cellular features of major groups of algae and their phylogenetic and adaptive significance. The basics of algal taxonomy are also covered. Not to be held with the former BIOL 3260.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031.

**Equiv To:** BOTN 2290

**Mutually Exclusive:** BIOL 3260

**Attributes:** Science

**BIOL 2300 Principles of Ecology 3 cr**

(Lab required) Principles of ecology at the individual, population, community, and ecosystems levels. This course is the normal prerequisite to other courses in ecology. May not be held with BIOL 2301, BIOL 2390, or AGECE 2370.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 1030 or BIOL 1031. Prerequisite or concurrent requirement: one of STAT 1150, STAT 1000, STAT 1001, or STAT 2220.

**Equiv To:** AGECE 2370, BIOL 2301, BOTN 2370, BOTN 2371, ZOO 2370, ZOO 2371

**Mutually Exclusive:** BIOL 2390, BOTN 2280, ZOO 2290

**Attributes:** Science

**BIOL 2301 Principes d'écologie 3 cr**

(Laboratoire requis) Principes d'écologie au niveau de l'individu, de la population, de la communauté et de l'écosystème. C'est normalement le cours préalable aux autres cours d'écologie. On ne peut se faire créditer BIOL 2301 et BIOL 2300, BIOL 2390 ou AGECE 2370.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Préalable : BIOL 1031 ou BIOL 1030. Préalable ou concomitant : un de STAT 1001, STAT 1000 ou STAT 1150.

**Equiv To:** AGECE 2371, BIOL 2300, BOTN 2370, BOTN 2371, ZOO 2370, ZOO 2371

**Mutually Exclusive:** BIOL 2390, BOTN 2280, ZOO 2290

**Attributes:** Université de Saint-Boniface

**BIOL 2380 Introductory Toxicology 3 cr**

A survey of general principles underlying the effects of toxic substances on biological systems, including consideration of the history, scope and applications of toxicology, the mechanisms of toxic action, and some major types of toxicants. This course is also taught in Environmental Science as ENVR 2180 and in Agriculture as AGRI 2180. May not be held with BIOL 2381, the former BIOL 2382, ENVR 2180, ENVR 2190, AGRI 2180 or AGRI 2190.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 1030, BIOL 1031, or HEAL 1502]; and [(CHEM 1100 or CHEM 1101) and (one of CHEM 1110, CHEM 1111, CHEM 1120, CHEM 1121, CHEM 1126, or CHEM 1130)] or (one of the former CHEM 1310, the former CHEM 1311, or the former CHEM 1320).

**Equiv To:** AGRI 2180, BIOL 2381, BOTN 2180, ENVR 2180, ZOO 2180

**Mutually Exclusive:** AGRI 2190, BIOL 2382, BOTN 2190, ENVR 2190, ZOO 2190

**Attributes:** Science

**BIOL 2390 Introductory Ecology 3 cr**

The course involves a study of the interrelationships of living organisms (including human) with each other and with their environment. It is not normally acceptable as a prerequisite to other courses in ecology. Not to be held with BIOL 2300, BIOL 2301, or AGECE 2370.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1010, BIOL 1030, BIOL 1031.

**Equiv To:** BOTN 2280, ZOO 2290

**Mutually Exclusive:** AGECE 2370, BIOL 2300, BIOL 2301, BOTN 2370, BOTN 2371, ZOO 2320, ZOO 2370, ZOO 2371

**Attributes:** Science

**BIOL 2410 Human Physiology 1 3 cr**

The mechanisms of action of the body's major control systems (nervous and endocrine) and of the muscular and reproductive systems are examined. Not to be held with BIOL 2411 or BIOL 3460.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031 or BIOL 1412; or a "C+" or better in both BIOL 1000 (or equivalent - BIOL 1001) and BIOL 1010 (or equivalent - BIOL 1011).

**Equiv To:** BIOL 2411, ZOO 2530, ZOO 2531

**Mutually Exclusive:** BIOL 1412, BIOL 1413, BIOL 3460, ZOO 1330, ZOO 3530

**Attributes:** Science

**BIOL 2420 Human Physiology 2 3 cr**

An examination of homeostatic regulation by the body's major effector organ systems (cardiovascular, respiratory, digestive, renal, and immune). Not to be held with BIOL 2421.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: Completion of BIOL 2410 (D), or BIOL 2411 (D), or BIOL 3460 (D); or consent of department.

**Equiv To:** BIOL 2421, ZOO 2540, ZOO 2541

**Attributes:** Science

**BIOL 2440 Human Reproductive Physiology 3 cr**

This course provides an in-depth understanding of human reproduction with particular emphasis on intrinsic control mechanisms and extrinsic methods of regulation of reproduction. This course also provides the basis for the understanding of alterations from normal mechanisms of reproductive processes. Check with the Department of Biological Sciences for course availability.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 1410 and BIOL 1412; or consent of department.

**Equiv To:** ZOO 2140

**Attributes:** Science

**BIOL 2500 Genetics 1 3 cr**

(Lab Required) Principles of heredity, gametogenesis and the cytological basis of inheritance in plants and animals. The concepts of dominance and genetic interaction, sex and inheritance, linkage, chromosomal variations, quantitative and population genetics, the genetic code. Not to be held with BIOL 2501 or PLNT 2520.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031.

**Equiv To:** BIOL 2501, BOTN 2460, BOTN 2461, PLNT 2520

**Mutually Exclusive:** MBIO 1410

**Attributes:** Science

**BIOL 2520 Cell Biology 3 cr**

The microscopic and submicroscopic aspects of cellular structure and function are considered with emphasis on the living cell as a dynamic system. Not to be held with BIOL 2521.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 1030, BIOL 1031.

**Equiv To:** BIOL 2521, ZOO 2280, ZOO 2281

**Attributes:** Science

**BIOL 2600 Introduction to Computational Biology 3 cr**

(Lab required) Biologists working in fields from genomics to ecology to physiology collect, analyze, and interpret their data using quantitative methods. More and more, biological researchers are encountering data (genomic, environmental, phenotypic) in unprecedented volumes that require new data handling approaches. The overall goal of this course is to introduce biology students to the types of biological questions that can be answered by applying computational methods to large-scale, publicly available data sets. The course will include a survey of several major public biological data repositories and will introduce students to the tools that biologists use to access, explore, analyze and visualize these data. This course is restricted to Faculty of Science students in a Major or Honours program.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: (BIOL 1030 or BIOL 1031) or [(STAT 1150 or (STAT 1000 and STAT 2000)) and (one of BIOL 1000, BIOL 1001, BIOL 1010, or BIOL 1011)].

**Attributes:** Science

**BIOL 2890 Special Topics in Biology 3 cr**

Biology encompasses a broad array of ideas and special topic areas. In this course, students can pursue a specific topic in detail through lectures, seminars and research projects. Normally taken by declared Honours and Major students in Biological Sciences. This course can be completed as a topics course multiple times under different titles.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: consent of department.

**Attributes:** Science

**BIOL 2892 Special Topics in Biology with Laboratory 3 cr**

(Lab required) Biology encompasses a broad array of ideas and special topic areas. In this course, students can pursue a specific topic in detail through lectures, laboratories, seminars and research projects. Normally taken by declared Honours and Major students in Biological Sciences. This course can be completed as a topics course multiple times under different titles.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: consent of department.

**Attributes:** Science

**BIOL 3100 Skills in Biological Sciences 3 cr**

This course will introduce students to the concepts and skills necessary to succeed in a research directed Biology-based career, including: communication skills (scientific writing and oral presentations), critical thinking, strategies for employment and graduate training, familiarization with the range of biological research, and exposure to a variety of Biology-based careers. This course is restricted to Honours students in the Biological Sciences or departmental permission.

**Equiv To:** BOTN 3570, ZOO 3750

**Attributes:** Science

**BIOL 3200 Advanced Invertebrate Biology 3 cr**

Topics of current interest within diverse phyla of Invertebrates to be surveyed. Students may develop approved research proposals and present up-to-date research summaries.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2200 or BIOL 2201.

**Equiv To:** ZOO 3610

**Attributes:** Science

**BIOL 3242 Vascular Flora of Manitoba 3 cr**

(Lab Required) A survey of the vascular plants of Manitoba emphasizing identification, nomenclature and classification, and including brief accounts of the distribution and post-glacial history of the main floristic associations within the province. Students must submit a collection of at least 20 different vascular plants identified to species. A guide to the collection should be obtained from the Department of Biological Sciences office in the Spring/Summer prior to commencing the course.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2240 or BIOL 2242 or permission of the department.

**Equiv To:** BOTN 3070

**Attributes:** Science

**BIOL 3250 Lichens and Bryophytes 3 cr**

(Lab required) The biology, evolution, and ecology of lichens and bryophytes. Emphasis is placed on the role of lichens and bryophytes in the ecosystem, gene flow, animal interactions, co-evolution, secondary compounds, and species identification. May not be held with the former BIOL 3240 or the former BIOL 4246.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2240 or BIOL 2260 or BIOL 2261.

**Mutually Exclusive:** BIOL 3240, BIOL 4246, BOTN 3260, BOTN 4050

**Attributes:** Science

**BIOL 3270 Introductory Parasitology 3 cr**

(Lab required) General course covering major parasitic phyla: namely, Protozoa, Platyhelminthes, Aschelminthes, Acanthocephala, and Arthropoda. Emphasis will be on principles of parasitology.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2200 or BIOL 2201; or consent of department.

**Equiv To:** ZOO 3460

**Attributes:** Science

**BIOL 3280 Forest Botany 3 cr**

An examination of the structure and dynamics of plant communities in forested ecosystems. Topics include forest type classification, physiological and anatomical responses of representative forest species, decomposition and nutrient cycling, disturbance and forest succession.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 2242; and one of BIOL 2300, BIOL 2301 or AGEC 2370; or consent of the department.

**Equiv To:** BOTN 3270

**Attributes:** Science

**BIOL 3290 Medicinal and Hallucinogenic Plants 3 cr**

A botanical and historical survey of medicinal, hallucinogenic and poisonous plants used in various cultures. Not to be held with BIOL 3291.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: a minimum of 30 hours of university credit, or consent of department.

**Equiv To:** BIOL 3291, BOTN 3280

**Attributes:** Science

**BIOL 3300 Evolutionary Biology 3 cr**

(Lab Required) Evolution is the ultimate cause of biological diversity.

This course introduces the major questions and research methods in evolutionary biology. Topics include evolutionary genetics, adaptation, speciation, and the reconstruction of evolutionary history.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: one of BIOL 2500, BIOL 2501, or PLNT 2520; and any one of the following: BIOL 2200, BIOL 2210, BIOL 2231, BIOL 2240, BIOL 2260, BIOL 2261, BIOL 3260; or consent of department.

**Equiv To:** BOTN 3000, ZOO 3000, ZOO 3001

**Attributes:** Science

**BIOL 3310 Foundations of Population Ecology 3 cr**

(Lab Required) The study of living populations, through experimentation and theory, will be examined. Topics investigated will include population regulation, competition, predation, disease, harvest, nonlinear and spatial dynamics and individual based models. Concepts and methods are reinforced through tutorials and evaluated by assignments and examinations.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 2000, or STAT 2001] or consent of department.

**Equiv To:** ZOO 3680

**Attributes:** Science

**BIOL 3312 Community Ecology 3 cr**

Lectures and laboratories emphasizing the structure and function of terrestrial biotic communities with emphasis upon selected Manitoba situations.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, STAT 1001, or AGRI 2400]; or consent of department.

**Equiv To:** BOTN 3540

**Attributes:** Science

**BIOL 3314 Field Ecology 3 cr**

Lectures and field exercises examine problems, techniques, and assumptions involved in measuring parameters of biological populations, communities, and environmental variables. The bulk of this course will be delivered during a field trip to a site determined by the instructor.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 2000, or STAT 2001]; or consent of department.

**Equiv To:** BOTN 3420, ZOO 3450

**Attributes:** Science

**BIOL 3318 Boreal Ecology 3 cr**

A survey of ecological factors in the formation, evolution, and survival of northern biota.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Equiv To:** ZOO 3380

**Attributes:** Science

**BIOL 3340 Biology of Primitive Fungi and Allies 3 cr**

Studies on the evolution of ancestral fungi, relevant Chromista and slime molds within the broader context of evolution of derived fungi and ancient groups basal to fungi and animals. The course also encompasses cogent life histories, development, structure, taxonomy, and fundamental biochemistry. General methods for environmental collection, isolation and study of these organisms will be presented in lectures.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2260 or BIOL 2261, or consent of the department.

**Attributes:** Science

**BIOL 3350 Data Analysis in Ecology 3 cr**

This course will consider methods of collection and analysis of ecological data, emphasizing experimental design of ecological studies, sampling, analysis of ecological data sets, and presentation techniques. May not be held with the former BIOL 4320.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 2000, or STAT 2001]; or consent of department.

**Mutually Exclusive:** BIOL 4320, ZOO 4200

**Attributes:** Science

**BIOL 3360 Animal Behaviour 3 cr**

An introduction to the study of animal behaviour, including mechanisms and evolutionary explanations of behaviour, as well as current ideas in animal behaviour. Topics include the genetic, physiological aspects of behaviour, and introductions to key topics in behavioural ecology.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001] and [one of BIOL 2200, BIOL 2201, BIOL 2210, or BIOL 2231]; or consent of department.

**Equiv To:** ZOO 3100

**Attributes:** Science

**BIOL 3370 Limnology 3 cr**

(Lab required) Lectures and laboratories providing an introduction to the physics, chemistry and biology of lakes.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Equiv To:** ZOO 3500

**Attributes:** Science

**BIOL 3372 Wetland Ecology 3 cr**

Lectures and field exercises examine the biotic (algae, macrophytes, invertebrates, and vertebrates) and abiotic (hydrology, nutrient cycling) properties of Manitoba's wetlands. Various wetland types, including prairie potholes, peatlands, and coastal marshes will be considered in lectures and field work. The course is offered in Summer Session.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Equiv To:** BOTN 3580, ZOO 3580

**Attributes:** Science



**BIOL 3400 Plant Physiology 3 cr**

(Lab required) An integrative view of major physiological processes in plants, spanning the biochemical, cellular, tissue, organ and whole plant levels of organization. The focus will be on photosynthesis, respiration, plant water reactions, plant mineral nutrition, and the role of hormonal and extrinsic factors in the regulation of plant growth. This course is taught together with PLNT 3400. Students may not hold credit for both BIOL 3400 and PLNT 3400. May not be held with the former BIOL 3450 or the former PLNT 3500.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 2242; and [(one of CHEM 2700, CHEM 2701, MBIO 2700, or MBIO 2701) and (CHEM 2720 or CHEM 2721)], or [(CHEM 2730 or MBIO 2730) and CHEM 2740], or [one of the former CHEM 2360, the former CHEM 2361, the former CHEM 2770, the former MBIO 2360, the former MBIO 2361, or the former MBIO 2770]; or consent of the department.

**Equiv To:** PLNT 3400

**Mutually Exclusive:** BIOL 3450, BOTN 2020, PLNT 3500

**Attributes:** Science

**BIOL 3452 Environmental Plant Physiology 3 cr**

(Lab Required) A physiological study of plant-environment interactions with emphasis on the development of strategies to survive abiotic stresses including heat, cold, drought, flooding, shade, excess light and UV light. The unique mechanisms used by plants (including the fascinating carnivorous species) to obtain nutrients in deficient environments will also be covered.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 3400, the former BIOL 3450, PLNT 3400, or the former PLNT 3500 or consent of the department.

**Equiv To:** BOTN 3010

**Attributes:** Science

**BIOL 3470 Environmental Physiology of Animals 1 3 cr**

(Lab Required) This course is intended to acquaint students with some of the major environmental challenges encountered by animals and stresses the diversity of physiological solutions to these problems in aquatic and terrestrial organisms. Areas covered may include thermal biology, circulation, gas exchange and buoyancy regulation. Laboratories explore related subjects in various animals. This course may not be held for credit with the former BIOL 3462.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2200 or BIOL 2210; or consent of department.

**Mutually Exclusive:** BIOL 3462, ZOO 3540

**Attributes:** Science

**BIOL 3472 Environmental Physiology of Animals 2 3 cr**

(Lab Required) This course is intended to acquaint students with the control and integration of organ systems and body functions of animals, and their biochemical and physiological adaptations to environmental perturbations. Areas covered may include neuroendocrinology, excretion, and water, salt, and acid-base balance. Laboratories explore related subjects in various animals. This course may not be held for credit with BIOL 3460.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 2200 or BIOL 2210 or consent of department.

**Mutually Exclusive:** BIOL 3460, ZOO 3530

**Attributes:** Science

**BIOL 3500 Genetics 2 3 cr**

(Lab required) The course complements Genetics I (BIOL 2500, BIOL 2501) and deals with various aspects of linkage and crossing over, gene function, allelism, mutation and repair, the use of bacteria and viruses as genetic tools, basics of developmental genetics and extra-nuclear inheritance. May not be held with BIOL 3501.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2500, BIOL 2501, or PLNT 2520]; and one of [(one of CHEM 2710, CHEM 2711, MBIO 2710, or MBIO 2711) and (CHEM 2720 or CHEM 2721)] or [CHEM 2740 and (CHEM 2750 or MBIO 2750)] or [one of the former CHEM 2370, the former CHEM 2371, the former MBIO 2370, the former MBIO 2371, the former CHEM 2780, or the former MBIO 2780]; or consent of department.

**Equiv To:** BIOL 3501, BOTN 3460

**Attributes:** Science

**BIOL 3501 Génétique 2 3 cr**

(Laboratoire requis) Complément du cours d'introduction à la génétique BIOL 2501 (BIOL 2500). Présentation des divers aspects de la liaison génique et la recombinaison génique, de la fonction des gènes, l'allélisme, des mutations et de la réparation, de l'utilisation des bactéries et des virus comme outils génétiques, des bases de la génétique du développement et de l'hérédité extranucléaire. On ne peut se faire créditer BIOL 3501 et BIOL 3500.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Préalables : un de [BIOL 2501 ou BIOL 2500 ou PLNT 2520]; et un de [(CHEM 2711, CHEM 2710, MBIO 2711 ou MBIO 2710) et (CHEM 2721 ou CHEM 2720)] ou (CHEM 2740 et (CHEM 2750 ou MBIO 2750)] ou [un des anciens (CHEM 2371, CHEM 2370, MBIO 2371, MBIO 2370, CHEM 2780 ou MBIO 2780)] ou autorisation professorale.

**Equiv To:** BIOL 3500, BOTN 3460

**Attributes:** Université de Saint-Boniface

**BIOL 3542 Developmental Biology 3 cr**

Principles and concepts of developmental biology will be presented including early embryo development, tissue patterning, morphogenesis, germ cell formation, stem cell biology, organ and nervous system development, growth and regeneration. Fundamental developmental concepts as well as the cellular, genetic and molecular mechanisms behind development will be covered utilizing invertebrate, vertebrate and plant examples. May not be held with the former BIOL 2540.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2500, BIOL 2501, or PLNT 2520] and [one of BIOL 2520 or BIOL 2521], or consent of the department.

**Mutually Exclusive:** BIOL 2540, ZOO 2150

**Attributes:** Science

**BIOL 3550 Plant Anatomy 3 cr**

(Lab Required) A study of the anatomical aspects of the growth and development of plants cells, tissues and organs. Laboratory exercises will complement material.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2242.

**Equiv To:** BOTN 3190

**Attributes:** Science

**BIOL 3560 Comparative Animal Histology 3 cr**

(Lab Required) This course focuses on the cell and tissue organization of animals. Cell morphology and specialization, tissue types and a survey of the cellular and tissue organization of all organ systems are covered. The primary focus is on mammals but comparative aspects of other animal groups are also included. May not be held with BIOL 3561.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: one of BIOL 2210, BIOL 2520, or BIOL 2521.

**Equiv To:** BIOL 3561, ZOO 3060, ZOO 3061

**Attributes:** Science

**BIOL 3561 Histologie animale comparée 3 cr**

(Laboratoire requis). Étude de l'organisation cellulaire et tissulaire des animaux, de la morphologie cellulaire, de la spécialisation, des types de tissus et de l'organisation cellulaire et tissulaire de tous les systèmes. Accent mis sur les mammifères, mais des études comparatives avec d'autres groupes animaux seront aussi incluses. On ne peut se faire créditer BIOL 3561 et BIOL 3560.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Préalable: un de BIOL 2210, BIOL 2231, BIOL 2521 ou BIOL 2520.

**Equiv To:** BIOL 3560, ZOO 3060, ZOO 3061

**Attributes:** Université de Saint-Boniface

**BIOL 3600 Biological Diversity and Sustainability 3 cr**

Anthropogenic drivers of change of many components of biological diversity; the resulting impacts on ecosystem capacity to provide on-going goods and services that are essential constituents of well-being and ultimately sustainability.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGEC 2370] and [one of STAT 1000, STAT 1001, or STAT 1150].

**Attributes:** Science

**BIOL 3890 Special Topics in Biology 3 cr**

Biology encompasses a broad array of ideas and special topic areas. In this course, students can pursue a specific topic in detail through lectures, seminars and research projects. Normally taken by declared Honours and Major students in Biological Sciences. This course can be completed as a topics course multiple times under different titles.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: Consent of department.

**Attributes:** Science

**BIOL 3892 Special Topics in Biology with Laboratory 3 cr**

(Lab required) Biology encompasses a broad array of ideas and special topic areas. In this course, students can pursue a specific topic in detail through lectures, laboratories, seminars and research projects. Normally taken by declared Honours and Major students in Biological Sciences. This course can be completed as a topics course multiple times under different titles.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: Consent of department.

**Attributes:** Science

**BIOL 3980 Work Term 1 0 cr**

Work assignment in business, industry, or government for students registered in the Biological Sciences Cooperative Option. Requires submission of a written report covering the work completed during the four-month professional assignment. (Pass/Fail grade only).

**Equiv To:** BOTN 3980, ZOO 3980

**Attributes:** Science

**BIOL 3990 Work Term 2 0 cr**

Work assignment in business, industry, or government for students registered in the Biological Sciences Cooperative Option. Requires submission of a written report covering the work completed during the four-month professional assignment. (Pass/Fail grade only).

**Equiv To:** BOTN 3990, ZOO 3990

**Attributes:** Science

**BIOL 4100 Honours Thesis 6 cr**

The student will conduct a research project, chosen in consultation with a Biological Sciences faculty member acting as an advisor, and produce a thesis in which the project, the results and conclusions are presented. The student will defend the thesis at an oral examination held on completion of the thesis. This course is restricted to 3rd and 4th year Honours Biological Science students.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 3100 or consent of department.

**Equiv To:** BOTN 4600

**Mutually Exclusive:** ZOO 4110

**Attributes:** Science

**BIOL 4210 Biology of Fishes 3 cr**

(Lab Required) Lectures survey organ systems, life history, and the population biology of fishes. The ecological analysis of fish communities is addressed through a field trip and a series of workshops on the analysis of field data. Evaluation is based upon work related to the field trip and examinations based upon the lecture material.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2210 or BIOL 2231.

**Equiv To:** ZOO 4170

**Attributes:** Science

**BIOL 4212 Systematics and Biogeography of Fishes 3 cr**

(Lab Required) A study of the evolutionary history, interrelationships and distribution patterns of the fish-like vertebrates. Laboratories will cover the identification of the major groups of fish-like vertebrates.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2210 or BIOL 2231; or consent of department.

**Equiv To:** ZOO 4220

**Attributes:** Science

**BIOL 4214 Biology of Amphibians and Reptiles 3 cr**

(Lab Required) Lectures consider the evolution, biology and adaptations of amphibians and reptiles. Laboratories and student presentations will deal with classification, structure, identification, and methods of field and laboratory study of these animals.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2210 or BIOL 2231; or consent of department.

**Equiv To:** ZOO 4230

**Attributes:** Science

**BIOL 4216 Biology of Birds 3 cr**

(Lab required) Biology of birds including: morphology, systematics, evolution, life histories and breeding biology, ecology, migration, and distribution of birds.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2210 or BIOL 2231.

**Equiv To:** ZOO 4240

**Attributes:** Science

**BIOL 4218 Biology of Mammals 3 cr**

(Lab required) Structure, classification, evolution, life histories, biogeography and ecology of mammals, including conservation. Techniques of studying mammals. Identification of the mammals of Manitoba. Typically offered alternating years.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [BIOL 2210 or BIOL 2231]; and [one of BIOL 2300, BIOL 2301 or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Equiv To:** ZOOL 4250

**Attributes:** Science

**BIOL 4220 Marine Biodiversity 3 cr**

Examines key ecological principles governing the maintenance of marine biodiversity, particularly in northern ecosystems. Topics include the definitions and global patterns of biodiversity and the ecological mechanisms influencing changes in these patterns in the context of applied population, community and ecosystem ecology. The course will also emphasize practical solutions, including fisheries' harvest models and marine protected areas.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Equiv To:** ZOOL 4260

**Attributes:** Science

**BIOL 4262 Wildlife and Fisheries Parasitology 3 cr**

(Lab Required) Parasites of major vertebrate groups of economic importance in temperate regions. Emphasis on: identification, means of control, and how to evaluate the impact of parasites on animal populations. A major project is required.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 3270.

**Equiv To:** ZOOL 4720

**Attributes:** Science

**BIOL 4300 Evolution and Adaptation 3 cr**

Lectures and discussion on advances in evolutionary research. Topics will include systematics, evolutionary genetics, evolution and development, co-evolution, mating systems, species ranges, eco-evolutionary dynamics, and evolution in society. This course may not be held for credit with either of BIOL 4240 or BIOL 4242.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 3300.

**Mutually Exclusive:** BIOL 4240, BIOL 4242

**Attributes:** Science

**BIOL 4310 Applications of Population Ecology in Fisheries and Wildlife 3 cr**

(Lab Required) The material introduced in BIOL 3310 is developed into the quantitative analyses of field data to form a basis for conservation and management. Topics covered include: surplus harvest models, virtual population analysis, spatial population modeling, bioeconomics, and quantitative adaptive management. Concepts are reinforced through tutorials.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 3310.

**Equiv To:** ZOOL 4850

**Attributes:** Science

**BIOL 4312 Analysis of Biological Communities 3 cr**

A survey of methods and approaches to the analysis of biological and environmental data containing many variables. Offered in alternate years.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 2000, or STAT 2001].

**Equiv To:** BOTN 4650

**Mutually Exclusive:** BIOL 7440, BOTN 7440

**Attributes:** Science

**BIOL 4314 Arctic Field Ecology 3 cr**

This hands-on field course will be held in Churchill, MB. While participating in ongoing monitoring and research, students will learn techniques for estimating wildlife abundance, distribution, behaviour, and reproductive parameters. The course is offered in Summer Term. A field trip fee will be assessed in addition to tuition fees. May not be held with BIOL 4800 when topic is Arctic Field Ecology - Churchill, MB.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001] and instructor permission.

**Mutually Exclusive:** BIOL 4800

**Attributes:** Science

**BIOL 4330 Plant Interactions 3 cr**

This course examines the ecology of interactions between plants and their biotic environment - other plants, animals and soil microbes. This is a reading course. Students will participate in discussions of key papers, examine recent and historic literature, and write a term paper examining a selected topic.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2300; or consent of department.

**Equiv To:** BOTN 4150

**Attributes:** Science

**BIOL 4362 Behavioural Ecology and Cognitive Ethology 3 cr**

(Lab Required) Examines proximate and ultimate questions relating to mating and parental behaviour, communication, social parasitism and animal intellect to provide insight into the intimate relationship between behavioural evolution and the environment. Laboratory and field exercises complement major topics considered in lectures.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 3360 or consent of department.

**Equiv To:** ZOOL 4280

**Attributes:** Science

**BIOL 4374 Aquatic Botany 3 cr**

This course examines the relationship between algae, fungi and macrophytes, and the physical, chemical and biological properties of the aquatic environment. Specific adaptations to life in water, and patterns of distribution and succession in rivers, lakes and wetlands will be covered.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Equiv To:** BOTN 4010

**Attributes:** Science

**BIOL 4380 Environmental Toxicology 3 cr**

(Lab required) A survey of the principles governing the dynamics of chemicals in the environment, with emphasis on the biological systems, using case histories of known pollution problems.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 2300, BIOL 2301, or AGECE 2370]; and one of [(one of CHEM 2710, CHEM 2711, MBIO 2710, or MBIO 2711) and (CHEM 2720 or CHEM 2721)] or [(CHEM 2740) and (CHEM 2750 or MBIO 2750)], or [one of the former CHEM 2370, the former CHEM 2371, the former MBIO 2370, the former MBIO 2371, the former CHEM 2780, or the former MBIO 2780]; and (one of STAT 1150, STAT 1000, or STAT 1001); and (one of BIOL 2410, BIOL 2411, BIOL 3470, or BIOL 3472); or consent of department.

**Equiv To:** ZOOL 4840

**Attributes:** Science

**BIOL 4400 Revegetation of Disturbed Lands 3 cr**

A physiological and ecological study of disturbed plant communities with emphasis on stresses associated with both mining activities and agricultural practices and processes of assisted recovery.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [one of BIOL 3400, PLNT 3400, the former BIOL 3450, or the former PLNT 3500]; and [one of BIOL 2300, BIOL 2301, or AGECE 2370] and [one of STAT 1150, STAT 1000, or STAT 1001]; or consent of department.

**Attributes:** Science

**BIOL 4460 Comparative Animal Energetics 3 cr**

Energetic strategies of animals living in ecologically diverse environments. Integration of physiological, morphological and behavioural adaptations with an emphasis on vertebrate species.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 2210 or BIOL 2231; and one of BIOL 2410, BIOL 2411, BIOL 3470 (BIOL 3462), or BIOL 3472 (BIOL 3460); or consent of department.

**Equiv To:** ZOOL 4830

**Attributes:** Science

**BIOL 4470 Physiology of Excitable Cells 3 cr**

(Lab required) Information flow in the nervous system. Discovery of electrical properties of neurons, structure and function of ion channels and synapses are emphasized. This course is restricted to students in year 3 or 4 of a Major or Honours degree program in Biological Sciences or in the B.Sc. in Biosystems Engineering.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: [(BIOL 2410 or BIOL 2411) and (BIOL 2420 or BIOL 2421)] or [BIOL 3470 and BIOL 3472]; or consent of department.

**Equiv To:** ZOOL 4160

**Attributes:** Science

**BIOL 4480 Comparative Endocrinology 3 cr**

The structure, control, and function of vertebrate endocrine systems. BIOL 2520, BIOL 2521, one of BIOL 2410, BIOL 2411, BIOL 3470 or BIOL 3472, and a course in biochemistry are strongly recommended as prerequisites.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: one of BIOL 1030 or BIOL 1031 and successful completion of 60 credit hours of university coursework.

**Equiv To:** ZOOL 4600

**Attributes:** Science

**BIOL 4500 Molecular Genetics of Plant Development 3 cr**

Analysis of plant development at the molecular level. Recent advances in model system genetics will be highlighted including seedling, root, shoot, and flower development as well as environmental responses.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 2500 or BIOL 2501.

**Equiv To:** BOTN 4180

**Attributes:** Science

**BIOL 4510 Evolutionary Genetics 3 cr**

(Lab Required) Evolutionary genetic processes are the foundation upon which much of understanding of biology is built. This course uses lectures, discussions, and computer-based analyses of real data sets to introduce the core concepts of theoretical population genetics and the applications of these ideas for the study of evolution. May not be held with BIOL 4890 when the topic is "Evolutionary Genetics". Registration is restricted to students in the B.Sc. Honours or Major programs, including Co-op programs, in Biological Sciences and Genetics.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: (one of BIOL 3300, BIOL 3301, or consent of department) and (one of MATH 1200, MATH 1210, MATH 1211, MATH 1220, MATH 1230, MATH 1240, MATH 1241, MATH 1300, MATH 1301, MATH 1310, MATH 1500, MATH 1501, MATH 1510, MATH 1520, the former MATH 1530, or MATH 1690).

**Mutually Exclusive:** BIOL 4890

**Attributes:** Science

**BIOL 4540 Developmental Molecular Biology 3 cr**

(Lab Required) An examination of early development with emphasis on the molecular events. Sex determination, gametogenesis and early embryogenesis will be discussed.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 3542 or the former BIOL 2540; or consent of department.

**Equiv To:** ZOOL 4150

**Attributes:** Science

**BIOL 4542 Genes and Development 3 cr**

An in depth examination of selected topics in embryonic development, emphasizing the genetic control of the cell and molecular mechanisms that direct embryogenesis. The course emphasizes hypothesis testing and the evolution of development, including studies of both animal and plant development.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 2520 or BIOL 2521; and BIOL 3542 (or the former BIOL 2540); or consent of department.

**Equiv To:** ZOOL 4270

**Attributes:** Science

**BIOL 4544 Advanced Developmental and Cellular Biology 3 cr**

(Lab Required) The course focuses on contemporary concepts and approaches in developmental biology, including theoretical and practical aspects. The emphasis is on the laboratory component. May not be held with the former BIOL 3540.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 2520 or BIOL 2521 and BIOL 3542 or the former BIOL 2540; or consent of the department.

**Attributes:** Science



**BIOL 4554 Molecular Biology Techniques for Eukaryotes - DNA 3 cr**  
(Lab Required) A techniques intensive course focusing on the understanding of molecular biology techniques, troubleshooting problems, writing reproducible laboratory experiments for publications, accurate recording of procedures in lab journals, and bioinformatics exercises from a DNA perspective. This course is designed for 4th year undergraduate and graduate students interested in understanding the theory and application of molecular methods specifically focusing on eukaryotic DNA. Students will learn essential and cutting-edge molecular biology techniques involved in gene structure, amplification, transformation, and sequencing among others. This course may not be held for credit with BIOL 4552.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisite: BIOL 2520.

**Mutually Exclusive:** BIOL 4552  
**Attributes:** Science

**BIOL 4556 Molecular Biology Techniques for Eukaryotes - RNA 3 cr**  
(Lab Required) This is a "hands-on" techniques course designed for the 3rd and 4th year undergraduate level. The purpose of this course is to train students in the current molecular biology techniques dealing with highly sensitive RNA molecules. The students will learn all essential steps involved to identify the messenger RNA expression of a particular target protein in plant or animal (invertebrates) systems. This course may not be held for credit with BIOL 4552.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisite: BIOL 2520.

**Mutually Exclusive:** BIOL 4552  
**Attributes:** Science

**BIOL 4560 Microtechnique 3 cr**  
(Lab Required) This intensive course covers a spectrum of animal tissue and cell preparation techniques for microscopy and a survey of the variety of types of microscopy. These span all types of microscopy; live cell techniques, fixation and tissue processing methods for both paraffin embedding media and plastic media, sectioning and staining imaging and image processing, introduction to histochemistry and immunocytochemistry and electron microscopy. This is a practical course with a major hands-on laboratory emphasis. This course is restricted to students in year 3 or 4 of a Major or Honours degree program.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisites: BIOL 1030 or BIOL 1031 (C+); or consent of department.

**Equiv To:** ZOOL 4140  
**Attributes:** Science

**BIOL 4650 Biology and Society 3 cr**  
(Lab Required) An exploration of the intersection of biology with society and the societal implications of research in areas such as genetics, biotechnology, ecology and evolution through lectures and tutorials. The course will examine how biological research is presented in the public sphere, and consider common public misunderstandings of the science. Students will examine some of the ethical issues that arise in the practice and application of biological sciences and develop skills in the communication and clarification of biological principles to the public. Students must be enrolled in third year (or higher) of a major or honours program in Biological Sciences, Biotechnology or Genetics. May not be held with BIOL 4890 when titled "Biology and Society".

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisites: One of BIOL 2500, BIOL 2501 or PLNT 2520 (C+), or permission of instructor.

**Mutually Exclusive:** BIOL 4890  
**Attributes:** Science

**BIOL 4800 Special Topics in Field Biology 3 cr**  
Lectures, field studies and research projects on a selected topic. Course content to vary from year to year depending on instructor. Usually offered during the summer months.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisite: consent of department.

**Equiv To:** BOTN 4800, ZOOL 4800  
**Mutually Exclusive:** BIOL 4314  
**Attributes:** Science

**BIOL 4890 Special Topics in Biology 3 cr**  
Biology encompasses a broad array of ideas and special topic areas. In this course, students can pursue a specific topic in detail through lectures, seminars and research projects. Normally restricted to third and fourth year Honours and Major students.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisite: Consent of department.

**Equiv To:** BOTN 4890, ZOOL 4890  
**Mutually Exclusive:** BIOL 4510, BIOL 4650  
**Attributes:** Science

**BIOL 4892 Special Topics in Biology with Laboratory 3 cr**  
(Lab required) Biology encompasses a broad array of ideas and special topic areas. In this course, students can pursue a specific topic in detail through lectures, laboratories, seminars and research projects. Restricted to third and fourth year Honours and Major students in Biological Sciences. Space permitting students in other programs will be permitted to register. This course can be completed as a topics course multiple times under different titles.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**  
Prerequisite: consent of department.

**Attributes:** Science

**BIOL 4980 Work Term 3 0 cr**  
Work assignment in business, industry, or government for students registered in the Biological Sciences Cooperative Option. Requires submission of a written report covering the work completed during the four-month professional assignment. (Pass/Fail grade only).

**Equiv To:** BOTN 4980, ZOOL 4980  
**Attributes:** Science

**BIOL 4990 Work Term 4 0 cr**  
Work assignment in business, industry, or government for students registered in the Biological Sciences Cooperative Option. Requires submission of a written report covering the work completed during the four-month professional assignment. (Pass/Fail grade only).

**Equiv To:** BOTN 4990, ZOOL 4990  
**Attributes:** Science