BIOLOGY

Departmental Notes

Subject Code: BIOL
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Overview
Queen's Biology students have the opportunity to explore the full breadth of biology: the inner workings of cells; the integrative biology of organisms; the interactions between organisms in ecological communities; and the central roles of genetics and evolution in shaping the diversity of life. Hands-on laboratory exercises, field courses offered locally at our renowned Queen's University Biological Station (https://qubs.ca/home/) and around the world, and independent research opportunities in professors' laboratories on selected topics are hallmarks of a Degree Plan in Biology. The mission of Queen's Biology is to prepare graduating students to be engaged, independent, and critically thinking citizens, well-prepared for further study and with a variety of career options.

Departmental Policies
Academic policies of the Department of Biology are outlined on the Department's website (https://biology.queensu.ca/) and course syllabi. Some Biology courses may require students to cover costs such as laboratory manuals and field trips. Laboratory manuals may contain important information on issues specific to the course of study such as laboratory safety, the ethical use of animals, and academic integrity. All students are expected to read and follow these departmental policies, which complement the Code of Conduct and Academic Regulations (https://queensu-ca-public.courseleaf.com/arts-science/academic-regulations/) described elsewhere in this Calendar and on the Biology website.

Advice to Students
Students have some flexibility in selecting courses that can be credited toward biology concentrations. However, judicious planning is required in order to avoid conflicts. For example, physics is optional for B.Sc. degree plans but is recommended in specific areas of biology. To avoid course conflicts in upper years, students are advised to plan their course of study in consultation with an Academic Adviser in the Department of Biology upon admission, and again at the beginning of second year. Academic Advisers are available for consultation and program approval.

To assist students in designing a Biology degree Plan, planners for four different course streams are described on the departmental website. These streams are

1. Genetics and Molecular Biology,
2. Plant Biology,
3. Integrative Animal Biology, and
4. Ecology and Evolutionary Biology,

each representing a sub-discipline within biology corresponding to teaching and research specializations of faculty within the Department of Biology. Students who wish to cater their degree Plan and specialize in one of these areas are encouraged to use the appropriate planner to help in mapping out course selections. Suggestions are given for courses to select from Biology as well as supporting courses that are offered by other departments. Course streams are not formal degree Plan options in Biology, and some students may prefer to sample broadly from across all four areas.

Students wishing to take a single elective course in Biology are advised to take BIOL 110 Human Genetics and Evolution/3.0, BIOL 111 Ecology and the Environment/3.0, or BIOL 350 Evolution and Human Affairs/3.0. Those wishing to take more elective courses in Biology are advised to consider that most courses have prerequisites, which include the core courses described in the following Plans.
Special Study Opportunities

Admission to 400- and 500-level Biology Courses

Admission to 400- and 500-level Biology courses requires a minimum cumulative GPA of 2.0 in any previously taken courses from the Biological Foundations List (BIOL_FNDS) regardless of Degree Plan. Requests for special consideration must be submitted to the Chair of Undergraduate Studies (kok@queensu.ca).

BIOL_FNDS

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 102</td>
<td>Fundamentals of Biology: Molecular and Cell Biology</td>
<td>3.00</td>
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<tr>
<td>BIOL 103</td>
<td>Fundamentals of Biology: Organisms to Ecosystems</td>
<td>3.00</td>
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<tr>
<td>BIOL 200</td>
<td>Diversity Of Life</td>
<td>3.00</td>
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<td>BIOL 205</td>
<td>Mendelian and Molecular Genetics</td>
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<td>BIOL 206</td>
<td>Evolutionary Genetics</td>
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<td>BIOL 212</td>
<td>Scientific Methods in Biology</td>
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<td>BIOL 300</td>
<td>Ecology</td>
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<tr>
<td>BIOL 330</td>
<td>Cell Biology</td>
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<td>BIOL 334</td>
<td>Comparative Biochemistry</td>
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<tr>
<td>BIOL 339</td>
<td>Animal Physiology</td>
<td>3.00</td>
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<tr>
<td>BIOL 341</td>
<td>Plant Physiology</td>
<td>3.00</td>
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Advanced Honours Seminars

BIOL 501 – BIOL 535

Biology offers a series of advanced 3.0 unit seminars with emphases on reading primary literature, writing, presentation skills, and experimental enquiry. Small class sizes and extensive interaction with faculty help promote an independent, discovery-based learning experience. Topics and course numberings for seminar offerings vary from year to year and are listed each spring for third-year students to consider. Normally, due to enrolment restrictions, students taking BIOL 537 Research in Biology will be permitted to take only one of these seminar courses and all other fourth-year students will be permitted to take a maximum of two. Preferred access will be given to students at Level 4 and registered in a B.Sc.(Hons.) program with a BIOL Plan.

Honours Thesis

BIOL 537 Research in Biology

The thesis course in Biology is a 12.0-unit, two-semester immersion in research that provides ideal preparation for graduate studies and research. Students follow the main steps of a graduate degree on a compressed schedule, from conception and proposal of a project to its execution, presentation in the form of a poster and public talk, a written thesis and a formal defense. Third-year students should consult the Biology website for further information on the faculty members offering BIOL 537 Research in Biology placements, the specific projects available, and details on the application process.

Research Mentorship

BIOL 538 Research Mentorship in Biology I, BIOL 539 Research Mentorship in Biology II, BIOL 540 Research Mentorship in Biology

This family of courses offers students the opportunity to arrange, with a Biology faculty member and permission of the Department, a placement in a laboratory and literature-based research project of either 3.0 or 6.0 units. Students undertaking a Research Mentorship gain the hands-on experience of contributing to an active research laboratory and interacting with the researchers, as well as undertaking a customized independent study that compliments the laboratory's research program.

Field Studies in Biology

BIOL 307 Field Biology I, BIOL 317 Field Biology II, BIOL 327 Field Biology III

The Department of Biology is an active participant in the Ontario Universities' Program in Field Biology (OUPFB) and a leader among Canadian universities in providing unique learning experiences via one- and two-week modules locally and around the globe. Superb resources are available close to Kingston at our Queen's University Biological Station and the Elbow Lake Environmental Education Centre, and recent courses have touched every continent except for Antarctica.

Faculty


**Programs**

- **Biological and Mathematics – Specialization (Science)** – Bachelor of Science (Honours) (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-mathematics-specialization-science-bs-honours/)
- **Biological and Psychology – Specialization (Science)** – Bachelor of Science (Honours) (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-psychology-specialization-science-bs-honours/)
- **Biotechnology – Specialization (Science)** – Bachelor of Science (Honours) (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biotechnology-specialization-science-bs-honours/)
- **Environmental Biology – Specialization (Science)** – Bachelor of Science (Honours) (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/environmental-biology-specialization-science-bs-honours/)
- **Biology – Major (Science)** – Bachelor of Science (Honours) (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-major-science-bs-honours/)
- **Biology – General (Arts)** – Bachelor of Arts (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-general-arts-ba)
- **Biology – General (Science)** – Bachelor of Science (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-general-science-bs/)
- **Biology – Minor (Arts)** (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-minor-arts/)
- **Biology – Minor (Science)** (https://queensu.ca/public.courseleaf.com/arts-science/schools-departments-programs/biology/biology-minor-science/)

**Courses**

**BIOL 1LEC Unspecified Lecture-100 Level Units: 6.00**

**Offering Faculty:** Faculty of Arts and Science
BIOL 102 Fundamentals of Biology: Molecular and Cell Biology Units: 3.00
The essential biochemistry, genetics, cell biology, and metabolic pathways underlying the survival and success of all living organisms. Themes and case studies could range from the application of genetic engineering in biotechnology to the role of cellular dysregulation in inheritable diseases.
NOTE Also offered online. Consult Arts and Science Online. Learning Hours may vary.
NOTE Also offered at the Bader International Study Centre, Herstmonceux. Learning Hours may vary.
LEARNING HOURS 111 (24L;6Lb;9G;12O;60P).
Requirements: Prerequisite None. Recommended 4U Biology and Chemistry, or equivalent high school background.
Offering Faculty: Faculty of Arts and Science

BIOL 103 Fundamentals of Biology: Organisms to Ecosystems Units: 3.00
The origins and diversification of multicellular organisms, their form, function and adaptation to stress and a changing world. Themes and case studies include energy flow from molecules to ecosystems, organismal interactions including parasitism and disease dynamics, and the impacts of human activity.
NOTE Also offered online. Consult Arts and Science Online. Learning Hours may vary.
NOTE Also offered at the Bader International Study Centre, Herstmonceux. Learning Hours may vary.
LEARNING HOURS 123 (36L;24Lb;24O;39P).
Requirements: Prerequisite None. Recommended BIOL 102.
Offering Faculty: Faculty of Arts and Science

BIOL 110 Human Genetics and Evolution Units: 3.00
Introductory genetics and evolutionary processes as they relate to the human condition - genetic diseases, medical techniques, inheritance and ethical issues such as cloning and genetically modified foods.
NOTE Also offered online. Consult Arts and Science Online. Learning Hours may vary.
LEARNING HOURS 118 (26L;10T;10G;36O;36P)
Requirements: Prerequisite None. One-Way Exclusion May not be taken with or after BIOL 102; BIOL 103.
Offering Faculty: Faculty of Arts and Science

BIOL 111 Ecology and the Environment Units: 3.00
Introduces the basic concepts of ecology and shows how they relate to environmental issues such as population growth, resource management, biodiversity, agriculture, air and water pollution, energy, and climate change, and to solutions leading to a sustainable environment.
NOTE Also offered online. Consult Arts and Science Online. Learning Hours may vary.
LEARNING HOURS 108 (36L;72P)
Requirements: Prerequisite None. One-Way Exclusion May not be taken with or after BIOL 300; BIOL 302; BIOL 303.
Offering Faculty: Faculty of Arts and Science

BIOL 200 Diversity Of Life Units: 3.00
This course provides a phylogenetically based overview of biodiversity across the Tree of Life including viruses; archaea, bacteria, algae, fungi, plants, invertebrates and vertebrates. Patterns of organizational complexity and species diversity are explained in the context of evolutionary processes, structure function relationships and ecology.
NOTE Textbook and onQ course site for distributing reading material.
LEARNING HOURS 120 (36L;18T;18O;48P)
Requirements: Prerequisite None. Exclusion BIOL 201; BIOL 202. Equivalency BIOL 201; BIOL 202. Recommended BIOL 102 and BIOL 103.
Offering Faculty: Faculty of Arts and Science

BIOL 205 Mendelian and Molecular Genetics Units: 3.00
An introduction to Mendelian and molecular genetics covering the basic mechanisms of genetic transmission, gene structure and function, as well as the application of molecular genetics in medicine and biotechnology.
LEARNING HOURS 120 (36L;18T;18O;48P)
Requirements: Prerequisite A GPA of 1.90 in (BIOL 102 and BIOL 103).
Offering Faculty: Faculty of Arts and Science

BIOL 206 Evolutionary Genetics Units: 3.00
An introduction to the genetic mechanisms of population differentiation and evolutionary change - from molecules to species. The genetical theory of evolution is also applied to problems involving conservation, biotechnology and the evolution of disease.
NOTE Priority to BIOL concentrators will be given during course selection.
LEARNING HOURS 120 (36L;18T;18O;48P)
Requirements: Prerequisite A minimum grade of a C- in BIOL 205.
Offering Faculty: Faculty of Arts and Science
BIOL 212 Scientific Methods in Biology  Units: 3.00
A hands on laboratory course that establishes the fundamentals of scientific investigation and applies them to selected biological questions. Students will learn to develop hypotheses, design and execute experiments, and to analyze and present results. There will be four modules structured as: Cell, Organism, Population and Ecosystem.
NOTE Blended learning, online material and hands on activities in the lab.
NOTE QUBS Field Trip. Estimated cost $35.
LEARNING HOURS 122 (8L;66Lb;24O;24P).
Requirements: Prerequisite A GPA of 1.90 in (BIOL 102 and BIOL 103).
Offering Faculty: Faculty of Arts and Science

BIOL 243 Introduction to Statistics  Units: 3.00
An introduction to the analysis of data from real life situations. Covers study design, descriptive and inferential statistics. Topics include probability, t-tests, regression, Chi-square tests, analysis of variance. Emphasis is in the foundation of statistical inference and practical application of statistical methods using statistical software.
LEARNING HOURS 120 (36L;12T;72P)
Requirements: Prerequisite None. Exclusion CHEE 209; COMM 162; ECON 250; GPHY 247; KNPE 251; NURS 323, PHED 251; POLS 385; PSYC 202; SOCY 211; STAM 200; STAT 263; STAT 267; STAT 367. One-Way Exclusion May not be taken with or after STAT 269.
Offering Faculty: Faculty of Arts and Science

BIOL 300 Ecology  Units: 3.00
An exploration of the relationships between living things and their environment in an evolutionary framework. Topics include constraints, organismal ecology, population dynamics, interactions, community structure, energy and elemental flow through ecosystems, and global diversity patterns. We will collect, analyze, and interpret ecological data.
NOTE In-person version includes a required field trip (additional cost)
LEARNING HOURS 118 (36L;21Lb;12O;16Oc;33P)
EQUIVALENCY BIOL 302/3.0 and/or BIOL 303/3.0.
Requirements: Prerequisite BIOL 103. Recommended BIOL 206, BIOL 212, and second year statistics (e.g. BIOL 243, PSYC 202, STAT 269).
Offering Faculty: Faculty of Arts and Science

BIOL 307 Field Biology I  Units: 3.00
Two weeks of field work plus written assignments in one or two areas of study to be done when specialized modules are available in May, July, August or February. Studies may include ecology of birds, fish, insects, small mammals, plants, tundra and taiga, lakes and caves. The schedule of offerings for each year is available in January.
NOTE Field trip: estimated cost of each module and the schedule of offerings for each year is available in January.
Requirements: Prerequisite (BIOL 102 and BIOL 103) and registration in a (BIOL Major, BIOL Science Minor/General or a BIMA, BIPS, BTEC or EBIO Specialization).
Offering Faculty: Faculty of Arts and Science

BIOL 308 Field Studies in Biology I  Units: 1.50
One week of field work plus written assignments in one or two areas of study to be done when specialized modules are available in May, July, August or February. Studies may include ecology of birds, fish, insects, small mammals, plants, tundra and taiga, lakes and caves. The schedule of offerings for each year is available in January.
NOTE Field trip: estimated cost of each module and the schedule of offerings for each year is available in January.
Requirements: (BIOL201 AND BIOL202)
Offering Faculty: Faculty of Arts and Science

BIOL 315 Plants and Human Culture  Units: 3.00
Human civilization depends on plants. We have changed them and they have changed us. This course investigates the biology and evolution of valuable economic plants, the science of plant domestication and genetic manipulation, and how our interactions with plants have altered the economy, politics, and sociology of human civilization.
LEARNING HOURS 120 (36L;24O;60P)
Requirements: Prerequisite BIOL 102 and BIOL 103. Corequisite (BIOL 200 or BIOL 201).
Offering Faculty: Faculty of Arts and Science

BIOL 316 Fisheries Biology  Units: 3.00
An introduction to the basic principles of fisheries biology and examination of the biological foundations of current problems affecting the world's fisheries, with an emphasis on developing sound science-based strategies to resolve these problems.
LEARNING HOURS 120 (36L;84P)
Requirements: Prerequisite BIOL 103. Corequisite (BIOL 200 or BIOL 202). Equivalency BIOL 415.
Course Equivalencies: BIOL316, BIOL415
Offering Faculty: Faculty of Arts and Science
BIOL 317  Field Biology II  Units: 3.00  
Two weeks of field work plus written assignments in one or two areas of study to be done when specialized modules are available in May, July, August or February. Studies may include ecology of birds, fish, insects, small mammals, plants, tundra and taiga, lakes and caves. The schedule of offerings for each year is available in January.  
NOTE  Field trip: estimated cost of each module and the schedule of offerings for each year is available in January.  
Requirements: Prerequisite BIOL 307 and prior to registering in this course students must complete the application process, be placed in a module and complete the field work.  
Equivalency BIOL 407.  
Course Equivalencies: BIOL317, BIOL407  
Offering Faculty: Faculty of Arts and Science  

BIOL 319  Introduction to Ethnobotany  Units: 3.00  
Ethnobotany is the study of the relationships that exist between indigenous cultures and local flora. Case studies will be presented to examine the various categories of plant use, the importance of traditional knowledge to Western culture, and the role of plant conservation and cultural sustainability.  
NOTE Only offered online. Consult Arts and Science Online.  
Requirements: Prerequisite BIOL 102 and BIOL 103.  
Recommended BIOL 200 or BIOL 201.  
Offering Faculty: Faculty of Arts and Science  

BIOL 321  Animal Behaviour  Units: 3.00  
An evolutionary approach to the study of animal behaviour. This course explores processes and patterns in behaviour, with emphasis on perception, communication, foraging, spacing, reproduction and social behaviour in a variety of animals. Methods of studying and analyzing behaviour are explored through laboratory exercises.  
NOTE Also offered online. Consult Arts and Science Online.  
Learning Hours may vary.  
LEARNING HOURS 132 (36L;12T;12Lb;72P)  
RECOMMENDATION BIOL 202/3.0.  
Requirements: Prerequisite None. Corequisite 6.0 units from (BIOL 200; BIOL 201; BIOL 202; BIOL 205; BIOL 206).  
Recommended BIOL 200 or BIOL 202.  
Offering Faculty: Faculty of Arts and Science  

BIOL 322  Environmental Physiology of Animals  Units: 3.00  
A comparative examination of interaction between animals and their environment including: physiological adaptations to extreme environments (e.g., arctic, desert); responses to acute and chronic environmental stress (e.g., hypoxia, temperature); environmental regulation of normal physiological processes; uses of comparative models in other fields.  
LEARNING HOURS 120 (36L;24O;60P)  
Requirements: Prerequisite BIOL 339.  
Offering Faculty: Faculty of Arts and Science  

BIOL 323  Vertebrate Diversity and Evolution  Units: 3.00  
Vertebrate biodiversity including characteristics and adaptations of the major classes of the living vertebrates; major environmental and geological changes associated with vertebrate evolution.  
NOTE  Field trip: estimated cost $35.  
LEARNING HOURS 120 (36L;12Lb;72P)  
Requirements: Prerequisite BIOL 206 and (BIOL 200 or BIOL 201 or BIOL 202).  
Offering Faculty: Faculty of Arts and Science  

BIOL 327  Field Biology III  Units: 3.00  
Two weeks of field work plus written assignments in one or two areas of study to be done when specialized modules are available in May, July, August or February. Studies may include ecology of birds, fish, insects, small mammals, plants, tundra and taiga, lakes and caves. The schedule of offerings for each year is available in January.  
NOTE  Field trip: estimated cost of each module and the schedule of offerings for each year is available in January.  
Requirements: Prerequisite (BIOL 307 and BIOL 317) and prior to registering in this course, students must complete the application process, be placed in a module and complete the field work.  
Offering Faculty: Faculty of Arts and Science  

BIOL 330  Cell Biology  Units: 3.00  
An introduction to the cellular basis of biological variation. The course explores the control of cell function exerted by the nucleus, the pathways for building and fuelling cells, and the control of integrative cellular events.  
NOTE Also offered online. Consult Arts and Science Online.  
Learning Hours may vary.  
LEARNING HOURS 120 (36L;12T;24O;48P)  
Requirements: Prerequisite BIOL 205 or BCHM 218.  
Offering Faculty: Faculty of Arts and Science
**BIOL 331 Analytical Genomics** Units: 3.00
This course will explore the structure of genomes and the nature and origin of gene families as well as large scale functional genomics methods for analysis of novel gene function.
LEARNING HOURS 124 (36L;12T;40O;36P)
**Requirements:** Prerequisite BIOL 205 or BCHM 218. Exclusion BCHM 370, BMED 370.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 333 Applied Biology** Units: 3.00
The course explores biological contributions to society in the fields of environmental assessment and management, materials and food production, and biotechnology. Emphasis is placed on understanding of applied processes in relevant service and production industries.
**Requirements:** Prerequisite BIOL 205 and (BIOL 200 or BIOL 201).
**Offering Faculty:** Faculty of Arts and Science

**BIOL 334 Comparative Biochemistry** Units: 3.00
A survey of selected topics including: general principles of enzymology; bioenergetics; metabolism and its control; the importance of proteomic and enzyme research in functional genomics and biotechnology; mechanisms whereby animals and plants acclimate at the biochemical level to environmental stress.
LEARNING HOURS 110.4 (36L;24O;50.4P).
**Requirements:** Prerequisite BIOL 103 and CHEM 112 and (BIOL 205 or BCHM 218). Note Priority enrolment will be given to students registered in a BIOL Plan or who require this course for their program.
**Course Equivalencies:** BIOL234, BIOL334
**Offering Faculty:** Faculty of Arts and Science

**BIOL 335 Limnology and Aquatic Ecology** Units: 3.00
Physics, chemistry and biology of freshwater lakes. Emphasis on: morphometry; light and temperature; water chemistry in relation to nutrients; physiological requirements; composition and interaction of algal and invertebrate populations; eutrophication; pollution; environmental change.
NOTE Field trip: estimated cost $35.
LEARNING HOURS 113 (36L;18Lb;8Oc;51P).
**Requirements:** Prerequisite CHEM 112. Recommended BIOL 200 or BIOL 201 or BIOL 202.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 339 Animal Physiology** Units: 3.00
Focus is placed on adaptive physiology and integrative function (nervous and hormonal, movement, excretion, circulation and digestion) with examples selected from various phylogenetic levels as appropriate.
LEARNING HOURS 120 (36L;18O;66P)
**Requirements:** Prerequisite BIOL 205 or BCHM 218.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 341 Plant Physiology** Units: 3.00
The course examines various aspects of plant cell biology, physiology, and biochemistry including carbon and nitrogen metabolism (photosynthesis, respiration, etc.), water relations, mineral nutrition, response to environmental stress, roles of plant hormones, plant biotechnology.
LEARNING HOURS 115 (36L;10G;15O;54P)
**Requirements:** Prerequisite BIOL 205 or BCHM 218.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 343 Data Analysis for Biologists** Units: 3.00
Advanced topics in using R for data management, exploratory data analysis, data visualization, and statistical analysis using the general linear model, with particular focus on statistical literacy and biological examples from both laboratory and field research.
LEARNING HOURS 120 (36L;12T;12O;60P)
**Requirements:** Prerequisite BIOL 243 or PSYC 202 or STAT 269.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 350 Evolution and Human Affairs** Units: 3.00
An exploration of how evolutionary thinking can affect our understanding of our lives, our species, and our ability to share the planet with other species.
NOTE Also offered online. Consult Arts and Science Online. Learning Hours may vary.
LEARNING HOURS 120 (36L;24O;60P)
**Requirements:** Prerequisite Level 3 or above.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 356 Biotechnology and Society** Units: 3.00
The contributions and effects of biotechnology on humanity will be explored from the perspective of their impacts on society including moral and ethical issues. Biotechnological contributions to society to be explored will include those in medicine, industry, and agriculture.
LEARNING HOURS 120 (36L;12T;72P)
**Requirements:** Prerequisite BIOL 205 or BCHM 218.
**Offering Faculty:** Faculty of Arts and Science

**BIOL 360 Sex and Evolution** Units: 3.00
Why sex? The evolutionary origins and consequences of sex and sexual reproduction. Topics include costs and benefits of sexual reproduction, the evolution and coevolution of sexes, gametes and genitalia, mating systems, gender differences and sex determination throughout the biotic world.
LEARNING HOURS 122 (36L;8T;18O;60P)
RECOMMENDATION BIOL 206/3.0.
**Requirements:** Prerequisite (BIOL 102 and BIOL 103) and 3.0 units from (BCHM 218; BIOL 200; BIOL 201; BIOL 202; BIOL 205 or BIOL 206). Recommended BIOL 206.
**Course Equivalencies:** BIOL210; BIOL369
**Offering Faculty:** Faculty of Arts and Science

Queens' University
BIOL 401 Experimental Approaches to Animal Physiology  Units: 3.00
Laboratory-based course emphasizing experimental approaches to understanding the principles of animal physiology covered in BIOL 339/3.0.
LEARNING HOURS 108 (36Lb;12T;60P)
Requirements: Prerequisite A minimum GPA of 2.0 in the Biological Foundations List. Corequisite BIOL 339.
Course Equivalencies: BIOL340; BIOL401
Offering Faculty: Faculty of Arts and Science

BIOL 402 Experiments in Plant Physiology  Units: 3.00
Laboratory-based course emphasizing experimental approaches to understanding the principles of plant physiology covered in BIOL 341/3.0.
LEARNING HOURS 114 (36Lb;24T;60;48P)
Requirements: Prerequisite A minimum GPA of 2.0 in the Biological Foundations List. Corequisite BIOL 341.
Course Equivalencies: BIOL342; BIOL402
Offering Faculty: Faculty of Arts and Science

BIOL 403 Experimental Techniques in Biology  Units: 3.00
Self-directed and self-selected hands-on experimental techniques used in fundamental biology research, biotechnologies, and medical sciences.
LEARNING HOURS 120 (36Lb;12T;72Oc)
Requirements: Prerequisite BIOL 205 and a minimum GPA of 2.0 in the Biological Foundations List.
Course Equivalencies: BIOL325;BIOL403
Offering Faculty: Faculty of Arts and Science

BIOL 404 Techniques in Molecular Biology  Units: 3.00
Intensive laboratory work (8h/day) to be carried out over two and a half weeks in May. Practical work includes DNA isolations, DNA cloning, PCR, production of proteins, biochemical and immunological analysis of proteins.
NOTE Priority to students registered in BIOL Major and Specialization degree Plans. See course website for details.
LEARNING HOURS 112.5 (100Lb;12.5P)
Requirements: Prerequisite (BCHM 218 or BIOL 330) and a minimum GPA of 2.0 in the Biological Foundations List.
Course Equivalencies: BIOL304, BIOL404
Offering Faculty: Faculty of Arts and Science

BIOL 407 Field Biology II  Units: 3.00
Requirements: BIOL307
Course Equivalencies: BIOL317, BIOL407
Offering Faculty: Faculty of Arts and Science

BIOL 409 Bioremediation  Units: 3.00
The use of living organisms to address environmental problems. Topics include mechanisms of contaminant extraction, absorption, concentration, and degradation using bacteria and plants to detoxify organic compounds, sequester heavy metals or clean up excess nutrients.
NOTE Field trip: estimated cost $40.
RECOMMENDATION BIOL 301/3.0 or BIOL 322/3.0 or BIOL 339/3.0 or BIOL 341/3.0 is recommended.
Requirements: Prerequisite BIOL 330 and a minimum GPA of 2.0 in the Biological Foundations List. Recommended BIOL 322 or BIOL 341 or BIOL 339.
Offering Faculty: Faculty of Arts and Science

BIOL 410 Ecology of Lakes and Streams  Units: 3.00
An in-depth look at the ecology and evolution of freshwater aquatic ecosystems, considering the role of populations, interspecific interactions, and the flow of energy and matter. There will be an emphasis on linking ecological theory with empirical evidence from aquatic systems. Topics will include dispersal and colonization, ecological genetics, resource competition, predator-prey interaction, evolution of life-history strategies, habitat coupling, and biogeochemical cycling.
LEARNING HOURS 120 (24L;12S;84P)
RECOMMENDATION BIOL 335/3.0.
Requirements: Prerequisite (BIOL 300 or BIOL 302 or BIOL 303) and a minimum GPA of 2.0 in the Biological Foundations List. Recommended BIOL 335.
Offering Faculty: Faculty of Arts and Science

BIOL 411 Global Change Biology  Units: 3.00
This course focuses on the fundamental biology underlying the major global change issues that humanity currently faces. Strong emphasis will be placed on the critical interconnections among issues across hierarchical levels from molecule to biosphere that explain the patterns and mechanisms which have led to our current environmental predicament.
LEARNING HOURS 117(24L;18T;12G;3Oc;36P)
Requirements: Prerequisite BIOL 300 and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science
BIOL 416 Terrestrial Ecosystems Units: 3.00
Principles of terrestrial ecosystem ecology: soils; plant-soil interactions; energy and water balance; carbon and nutrient cycling; species effects; landscape-level and whole earth biogeochemistry; global change.
NOTE Overnight field trip: cost $75.
LEARNING HOURS 124 (12L;24S;18Lb;12Pc;12G;12O;160c;18P)
Requirements: Prerequisite (BIOL 300 or BIOL 302 or BIOL 303 or GPHY 317) and a minimum GPA of 2.0 in the Biological Foundations List. One-Way Exclusion May not be taken with or after BIOL 510.
Offering Faculty: Faculty of Arts and Science

BIOL 418 Fisheries Techniques Units: 3.00
This course will introduce students to many "hands-on" techniques currently used in fisheries. This will include fish identification, different capture techniques for fisheries assessment, bioacoustics, environmental monitoring, techniques for ageing fish, diet analysis, fish tracking (biotelemetry approaches), and data management.
LEARNING HOURS 120 (30Lb;10T;40G;40P)
Requirements: Prerequisite BIOL 316/3.0 and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science

BIOL 422 Conservation Biology Units: 3.00
The application of biological research to the conservation of biodiversity and natural resources, as well as the interaction of biology with philosophy, politics and economics in influencing conservation policy.
NOTE A course fee to cover guest speakers and field trips of not more than $40.
LEARNING HOURS 108 (36L;36T;36P)
Requirements: Prerequisite BIOL 300 or BIOL 302 or BIOL 303 and a minimum GPA of 2.0 in the Biological Foundations List. Exclusion ENSC 320.
Offering Faculty: Faculty of Arts and Science

BIOL 423 Modern Insect Science Units: 3.00
An exploration into the world of insects, one of the most abundantly successful group of organisms on the earth.
NOTE An overnight field trip is estimated to cost $65; a limited number of bursaries may be available for exceptional circumstances; contact the instructor early in the previous term.
RECOMMENDATION BIOL 330/3.0 or MBIO 218/3.0
Requirements: Prerequisite BIOL 205 and a minimum GPA of 2.0 in the Biological Foundations List. One-Way Exclusion May not be taken with or after BIOL 507. Recommended BIOL 330 or BCHM 218.
Offering Faculty: Faculty of Arts and Science

BIOL 430 Molecular Genetics of Development Units: 3.00
The use of genetic analysis to understand developmental processes such as cell fate determination, pattern formation and morphogenesis. Emphasis will be on the molecular pathways used during embryonic development, highlighting applications and techniques using model organisms.
LEARNING HOURS 126 (36L;18S;24G;12L;12O;24P)
Requirements: Prerequisite (BCHM 218 or BIOL 330) and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science

BIOL 431 Cellular Basis of Adaptation Units: 3.00
The cellular origins of diversity in physiological processes, with consideration of the role of evolutionary, developmental and molecular mechanisms.
LEARNING HOURS 108 (6L;30S;8T;4G;60P)
Requirements: Prerequisite (BIOL 330 or BCHM 218) and (BIOL 301 or BIOL 334 or BIOL 338 or BIOL 339 or BIOL 341) and a minimum GPA of 2.0 in the Biological Foundation List.
Offering Faculty: Faculty of Arts and Science

BIOL 432 Computation and Big Data in Biology Units: 3.00
Application of basic coding and analytical methods to obtain, organize, analyze, visualize, and interpret information from large, complex datasets (i.e. 'Big Data') in biology. Datasets may include climate/weather records, 'omics' data, specimen collections, long-term observational studies, journal articles, and other historical and online sources.
LEARNING HOURS 120 (36L;12T;72P)
Requirements: Prerequisite A minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science

BIOL 433 History and Philosophy of Biology Units: 3.00
An examination of the foundations of evolution, classification and other selected topics from historical, philosophical and scientific perspectives.
LEARNING HOURS 120 (36L;24T;60P)
Requirements: Prerequisite (BIOL 300 or BIOL 302 or BIOL 303) and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science
BIOL 439  Natural Selection and Microevolution  Units: 3.00
The mechanisms of evolutionary change - from genes to societies. How natural selection interacts with genetic and population processes to make organisms adapted to their environment and to create biological diversity.
LEARNING HOURS 120 (36L;6S;18Lb;60P)
Requirements: Prerequisite (BIOL 300 or BIOL 302 or BIOL 303) and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science

BIOL 440  Speciation and Macroevolution  Units: 3.00
An exploration of higher-level processes in evolution spanning considerations of mechanisms of speciation, extinction, adaptive radiation, and phylogenetics.
LEARNING HOURS 120 (24L;24T;60G;12O)
Requirements: Prerequisite (BIOL 300 or BIOL 302 or BIOL 303) and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science

BIOL 441  Molecular Genetics  Units: 3.00
Research in eukaryotic molecular genetics with an emphasis on epigenetics. Epigenetic phenomena will be examined in a range of models from single-celled organisms to metazoans, with student discussions on topics as diverse as bioethics, disease controls, and eugenics.
LEARNING HOURS 125 (30L;8S;12Lb;10G;65P)
Requirements: Prerequisite (BIOL 330 or [PHGY 215 and PHGY 216] or PHGY 214) and a minimum GPA of 2.0 in the Biological Foundations List.
Exclusion PATH 425.
Offering Faculty: Faculty of Arts and Science

BIOL 442  Evolutionary Medicine  Units: 3.00
An exploration of human disease, illness, and injury, and the symptoms and treatments of medical conditions, with an evolutionary framework.
LEARNING HOURS 120 (24L;20T;10O;66P)
Requirements: Prerequisite BIOL 206 and a minimum GPA of 2.0 in the Biological Foundations List. Equivalency BIOL 522.
Course Equivalencies: BIOL442; BIOL522
Offering Faculty: Faculty of Arts and Science

BIOL 445  Neuroethology  Units: 3.00
The current status of research in the study of the neural control of the natural behaviour of animals. Topics include the detection and coding of information in the environment, the integration of this information in the process of decision-making, the generation of the motor patterns that underlie behaviour, and general constraints on form and function of neural circuits.
LEARNING HOURS 126 (36L;18T;24O;48P).
Requirements: Prerequisite (BIOL 339 or [PHGY 215 and PHGY 216] or PHGY 214) and a minimum GPA of 2.0 in the Biological Foundations List.
Offering Faculty: Faculty of Arts and Science

BIOL 501  Recent Research in Molecular  Units: 3.00
This course will focus on how molecular biology is used in basic and medical research to dissect the mechanisms involved in a large variety of biological problems. Students in the course will explore molecular literature and techniques that are relevant to their interest through seminar presentations, writing critiques, scientific reviews.
LEARNING HOURS 120 (36S;84P)
RECOMMENDATION BIOL 430/3.0.
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department. Recommended BIOL 430.
Offering Faculty: Faculty of Arts and Science

BIOL 502  Plant Cell Responses to Environmental Stress  Units: 3.00
This course will dissect signal transduction pathways and molecular responses in plants exposed to environmental stresses such as pathogen infection, drought, or temperature fluctuations. Emphasis is on understanding techniques used to investigate changes in gene expression, protein-protein interactions, sub-cellular localization, as well as the analysis of mutant and transgenic plant lines.
LEARNING HOURS 120 (36S;84P)
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and (BIOL 330 or BIOL 334 or BIOL 341 or BIOL 430) or permission of the Department.
Offering Faculty: Faculty of Arts and Science
BIOL 503 Plant Biotechnology Units: 3.00
This is an experiential course on the business of science and the steps leading to the commercialization of an agrobiotech product. Students will go through a series of workshops to develop their own ideas into a commercially valuable product, plus an assessment of all related social and economic issues using business-oriented exercises.
LEARNING HOURS 120 (15L;9S;24G;72P).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and (BIOL 205 or BCHM 218] and BIOL 341) or permission of the Department.
Offering Faculty: Faculty of Arts and Science

BIOL 504 Extremophiles Units: 3.00
The course explores biology of extraordinary organisms that flourish under conditions of stress and how more ordinary organisms deal with periodically unfavourable circumstances. Emphasis is placed on understanding of the relevant adaptations and processes involved.
NOTE No textbook is required. The course website will be used to provide lecture notes and assigned readings from scientific books, journals and selected websites.
LEARNING HOURS 116 (30L;2S;12G;12O;60P)
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and (BCHM 315 and BCHM 316) or permission of the Department. Exclusion BIOL 533.
Offering Faculty: Faculty of Arts and Science

BIOL 505 Cell Signaling in Development and Disease Units: 3.00
Organisms arise from a single cell into functional tissues, patterns, and structures by orchestrating cell behaviors, such as cell divisions, cell differentiation, pattern formations, cell shape changes and cell movements. This course will focus on the genetic and molecular analyses of how these cell behaviors occur.
NOTE No textbook is required. The course website will be used to provide lecture notes and assigned readings from scientific books, journals and selected websites.
LEARNING HOURS 120 (24L;12S;12G;24O;48P)
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and BIOL 330 or permission of Department. Exclusion BIOL 535.
Offering Faculty: Faculty of Arts and Science

BIOL 506 Biochemical Adaptations to Life Under Extreme Conditions Units: 3.00
Biochemical adaptation is a fundamental aspect of biological diversity because it integrates molecular structure, with metabolic function and control. The course evaluates the mechanisms whereby animals, plants, and microbes acclimate at the biochemical level to 'extreme' environmental conditions such as temperature stress, high pressure, hypoxia, salt stress, oxidative stress, and desiccation.
LEARNING HOURS 120 (36S;84P)
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and [BCHM 334 or (BCHM 315 and BCHM 316) or BCHM 310] or permission of the Department.
Offering Faculty: Faculty of Arts and Science

BIOL 507 Biotechnology Units: 3.00
This course covers the ethical, societal and environmental impacts of biotechnology. There will be critical analysis of public policy and the value of biotechnologies to science and the public. Topics will likely include synthetic biology, human cloning, xenotransplants, stem cells, nanomaterials, marine biotechnology, eugenics, patenting, GMOs and the release of biotech products to the environment.
LEARNING HOURS 120 (36S;84P).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department. One-Way Exclusion May not be taken with or after BIOL 441.
Offering Faculty: Faculty of Arts and Science

BIOL 508 Biology of the Cell Cycle Units: 3.00
Cell proliferation underlies development and tissue renewal and is implicated in many diseases. Our universal model of eukaryotic cell cycle control is based on studies in a number of model systems. The course will focus on control mechanisms, deriving information from systems as diverse as yeast and human cells.
LEARNING HOURS 120 (36S;84P).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and (BCHM 218) or permission of the Department.
Offering Faculty: Faculty of Arts and Science
BIOL 509 Limnological Environmental Studies  Units: 3.00
This course will explore ecological and evolutionary aspects of species invasions, with an emphasis on aquatic invaders. Course discussions will include such topics as invasive species and factors that influence their arrival, establishment, and spread, as well as management strategies that can be employed to reduce the arrival, establishment, and spread of invasive species.
LEARNING HOURS 120 (9L;9S;18G;84P).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIOP-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department. Recommended BIOL 335.
Offering Faculty: Faculty of Arts and Science

BIOL 510 The Biology of Sustainability  Units: 3.00
This ecology course will identify and critique potential mechanisms by which our civilization could most effectively move toward more sustainable living. The topic incorporates many fundamental aspects of biology, and each course iteration may include biogeochemical, ecological, economic, social, genetic, philosophical, and behavioural components.
LEARNING HOURS 120 (36S;12T;12G;36I;12O;12P).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIOP-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department. Recommended BIOL 300 or (BIOL 302 and 303).
Offering Faculty: Faculty of Arts and Science

BIOL 515 Aquaculture  Units: 3.00
This course will examine the influence of biotic and/or abiotic factors in aquaculture industries around the globe. We will explore the application of different biotechnologies in fishery industries and assess the potential impacts of various types of aquaculture practices on the environment and our fundamental socio-economical values.
LEARNING HOURS 120 (9L;9S;18G;84P).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIOP-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department. Recommended BIOL 300 or (BIOL 302 and 303).
Offering Faculty: Faculty of Arts and Science

BIOL 527 Paleolimnology and Global Environmental Change  Units: 3.00
This course is mainly to provide students with a background in studies of long-term environmental change, with a focus on research that is especially relevant to today's environmental problems. Key topics include: climatic change, lake pollution, atmospheric deposition of contaminants and related topics.
LEARNING HOURS 132 (21L;15S;96P)
RECOMMENDATION BIOL 335/3.0.
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIOP-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department. Recommended BIOL 335.
Offering Faculty: Faculty of Arts and Science

BIOL 530 Origins of Biodiversity  Units: 3.00
This course uses the latitudinal increase in diversity towards the equator as a launching point to explore how diversity forms, is maintained, and disappears, and why we find such dramatic variation in diversity around the world. Discussions will focus on both evolutionary and ecological perspectives of diversity, and we will review various hypotheses to explain latitudinal diversity gradients.
LEARNING HOURS 120 (9L;9S;18G;84P)
RECOMMENDATION BIOL 201/3.0 and BIOL 202/3.0 and (BIOL 302/3.0 or BIOL 303/3.0 or BIOL 439/3.0).
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIOP-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department.
Offering Faculty: Faculty of Arts and Science

BIOL 531 Darwinism and Cultural Evolution  Units: 3.00
Through seminars, essays, and group discussions, students explore ideas, research objectives, and recent discoveries in the application of Darwinian evolutionary theory to the interpretation of human nature, social life, and culture ¿ and how these advances impact on our understanding of civilization and the challenges it faces for the 21st century.
LEARNING HOURS 120 (9L;9S;18G;84P)
Requirements: pre BIOL350
Offering Faculty: Faculty of Arts and Science

BIOL 532 Selected Topics in Biology I  Units: 3.00
LEARNING HOURS 120 (9L;9S;18G;84P)
Requirements: Pre 4th yr in BIOL Honours Plan and a min. GPA of 2.0 in the BIOL_FNDS list and BIOL330.
Offering Faculty: Faculty of Arts and Science
BIOL 533  Selected Topics in Biology II  Units: 3.00  
LEARNING HOURS 120 (9L;9S;18G;84P)  
Requirements: Pre 4th yr in BIOL Honours Plan and a min. GPA of 2.0 in the BIOL_FNDS list.  
Offering Faculty: Faculty of Arts and Science  

BIOL 534  Selected Topics in Biology III  Units: 3.00  
LEARNING HOURS 120 (9L;9S;18G;84P)  
Requirements: Pre 4th yr in BIOL Honours Plan and a min. GPA of 2.0 in the BIOL_FNDS list.  
Offering Faculty: Faculty of Arts and Science  

BIOL 535  Selected Topics in Biology  Units: 3.00  
LEARNING HOURS 120 (9L;9S;18G;84P)  
Requirements: Prerequisite Level 4 or above and registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, BTEC-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List or permission of the Department.  
Offering Faculty: Faculty of Arts and Science  

BIOL 536  Selected Topics in Biology V  Units: 3.00  
LEARNING HOURS 120 (9L;9S;18G;84P)  
Requirements: Pre 4th yr in BIOL Honours Plan and a min. GPA of 2.0 in the BIOL_FNDS list.  
Offering Faculty: Faculty of Arts and Science  

BIOL 537  Research in Biology  Units: 12.00  
Individual research projects under the supervision of a staff member; reported in the form of a thesis, poster and seminar.  
NOTE In the spring preceding fourth year, students must select projects in consultation with potential supervisors. Registration is subject to availability of a supervisor. Work on the project during summer is advantageous if field studies are required. See also the statement on BIOL 501/3.0-BIOL 536/3.0 in the BIOL Department Information, preliminary information section.  
LEARNING HOURS 444 (8L;36S;300Pc;100O)  
Requirements: Prerequisite Admission to the final year of a BSCH program in Biology and a minimum GPA of 2.0 in the Biological Foundations List and permission of the project supervisor and course coordinator. Exclusion BIOL 541.  
Offering Faculty: Faculty of Arts and Science  

BIOL 538  Research Mentorship in Biology I  Units: 3.00  
Research practicum under the supervision of a Biology faculty member. The course will involve a combination of research in the host laboratory, attendance of BIOL 537 or other seminars in the Department, and literature research to present as a major paper and seminar.  
NOTE Students will normally be enrolled in the fourth year of their Program, having completed the third year core requirements of their Plan.  
Requirements: Prerequisite Registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and permission of the Department. One-Way Exclusion Not to be taken concurrently with BIOL 537.  
Offering Faculty: Faculty of Arts and Science  

BIOL 539  Research Mentorship in Biology II  Units: 3.00  
Research practicum under the supervision of a Biology faculty member. The course will involve a combination of research in the host laboratory, attendance of BIOL 537 or other seminars in the Department, and literature research to present as a major paper and seminar.  
NOTE Students will normally be enrolled in the fourth year of their Program, having completed the third year core requirements of their Plan.  
Requirements: Prerequisite Registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and permission of the Department. Corequisite BIOL 538. One-Way Exclusion Not to be taken concurrently with BIOL 537.  
Offering Faculty: Faculty of Arts and Science  

BIOL 540  Research Mentorship in Biology  Units: 6.00  
Research practicum under the supervision of a Biology faculty member. The course will involve a combination of research in the host laboratory, attendance of BIOL 537 or other seminars in the Department, and literature research to present as a major paper and seminar.  
NOTE Students will normally be enrolled in the fourth year of their Program, having completed the third year core requirements of their Plan.  
Requirements: Prerequisite Registration in a Biology Honours Plan (BIOL-M-BSH, BIOL-P-BSH, BIMA-P-BSH, BIPS-P-BSH, EBIO-P-BSH) and a minimum GPA of 2.0 in the Biological Foundations List and permission of the Department. One-Way Exclusion Not to be taken concurrently with BIOL 537.  
Course Equivalencies: BIOL540; BIOL540B  
Offering Faculty: Faculty of Arts and Science
BIOL 541 Research in Biotechnology Units: 12.00
Individual research projects under the supervision of a staff member; reported in the form of a thesis, poster, and seminar.
NOTE Students must select projects in consultation with potential supervisors a minimum of one full term in advance of starting the course.
LEARNING HOURS 446 (8L;18S;360Pc;60P)
Requirements: Prerequisite Admission to the final year of the BTEC program in Biology and a minimum GPA of 2.0 in the Biological Foundations List and permission of the project supervisor and course coordinator. Exclusion BIOL 537.
Offering Faculty: Faculty of Arts and Science

BIOL 594 Independent Study Units: 3.00
Offering Faculty: Faculty of Arts and Science

BIOL 595 Independent Study Units: 6.00
Offering Faculty: Faculty of Arts and Science

BIOL 596 Independent Study Units: 12.00
Offering Faculty: Faculty of Arts and Science

BIOL 597 Independent Study Units: 18.00
Offering Faculty: Faculty of Arts and Science

BIOL 598 Independent Study Units: 9.00
Offering Faculty: Faculty of Arts and Science

BIOL 799 Introduction To Animal Care Units: 6.00
Offering Faculty: Faculty of Arts and Science

BIOL 800 Introd. To Recomb. Dna Method. Units: 3.00
Offering Faculty: Faculty of Arts and Science

BIOL 801 Evolutionary Medicine Units: 3.00
A survey of the ways in which concepts from evolutionary biology can be used to better address and understand issues related to human health. Topics might include the evolutionary biology of infectious diseases, the utility of phylogenetics in infectious diseases, the evolution of drug (e.g., vaccines) and antibiotic resistance, the evolutionary biology of human genetic disorders, aging and senescence. Three term hours; fall. Not offered 2010-2011.
Offering Faculty: Faculty of Arts and Science

BIOL 806 Plant Molecular Biology Units: 3.00
Plant Molecular Biology
Offering Faculty: Faculty of Arts and Science

BIOL 811 Plant Metabolism Units: 3.00
This course explores contemporary research ideas and techniques used to elucidate plant metabolism and its control. Topics include plant signal transduction, plant metabolic adaptations to abiotic and biotic stress, as well as the application of proteomics, genomics, and molecular biology for comprehending plant metabolism and the production of 'improved' transgenic crops via metabolic engineering. Three term hours; fall. Not offered 2010-2011.
Offering Faculty: Faculty of Arts and Science

BIOL 812 Introduction to computational analysis in biology Units: 3.00
This course will be a hands-on introduction to essential bioinformatics skills. The goal is to build a foundation of computational skills that enable analysis of large biological data. We will learn command-line Unix/Linux, shell scripting, and installation/testing/usage of popular public bioinformatics packages. We will spend significant time learning Perl and/or Python and Matlab. The course will rely heavily on problem-based learning and in-class discussion. Assignments will involve analyses that use primary literature data, particularly next-gen sequencing data. 50% of the final grade is based on a research project conceived and carried out independently. No prior programming experience is necessary.
Offering Faculty: Faculty of Arts and Science

BIOL 813 Statistical and Machine Learning in Biology Units: 3.00
A course in advanced techniques for analyzing biological data. Possible topics include statistical and machine learning (e.g. likelihood models, Monte Carlo methods, approximate Bayesian computation), and neural networks (e.g. deep, recursive, convolutional). Topics covered will depend upon student and faculty interests. Lectures & Tutorials (3hrs).
Offering Faculty: Faculty of Arts and Science

BIOL 815 Neuronal Basis Of Behaviour Units: 3.00
The structure, function and interactions of nerve cells particularly with respect to how these relate to the generation of motor patterns and behaviour. Emphasis will be on the mechanisms underlying the plasticity of neuronal circuits. Invertebrate and vertebrate systems will be considered. Three term hours; fall. Not offered 2010-2011.
Offering Faculty: Faculty of Arts and Science
BIOL 816  Environmental Chemicals  Units: 3.00
The course will compare and contrast the behaviour of persistent, bioaccumulative and toxic compounds, such as methyl mercury and chlorinated aromatic compounds, with the behaviour of less persistent chemicals such as petroleum hydrocarbons and modern pesticides. Subjects of interest may include sediment diagenesis, long-range transport, methylation processes, and interactions between biomagnification and ecosystem structure and productivity. Three term-hours; fall. Not offered 2010-2011.
Offering Faculty: Faculty of Arts and Science

BIOL 817  Contemporary Issues In Biology  Units: 3.00
The focus will be on biological issues of current importance to provide a broad exposure within a range of specific disciplines. Topics will include critical analysis of biological issues that have been featured as news items either in the popular press or in science news journals within the previous 12 months. Three term hours; fall. C. Moyes.
Offering Faculty: Faculty of Arts and Science

BIOL 818  Stress Biology  Units: 3.00
Environmental stress is addressed with respect to water, nutrition, temperature, toxins, and competition between organisms. Topics include adaptations to cope with stress; biological responses at the organismal, cellular, biochemical, physiological and molecular genetic levels. No specialized molecular biology background is required. Three term hours; winter. W. Bendena.
Offering Faculty: Faculty of Arts and Science

BIOL 819  Selected Topics In Molecular Genetics  Units: 3.00
Topics will range from population genetics to transcriptional regulation in both plants and animals. Application of the tools of molecular genetics to biological problems will be emphasized. No previous specialization in molecular biology is required, although some background in this area is highly recommended. Three term hours; winter. W. Bendena.
Offering Faculty: Faculty of Arts and Science

BIOL 820  Commercialization Of Biological Research  Units: 3.00
Current issues relating to the biotechnology industry will be dealt with in detail. Topics covered include: grant writing; patenting; circumventing patents; funding sources; business plans; venture capital investments; public awareness; public perspective; and layperson presentations. Three term hours; TBA.
Offering Faculty: Faculty of Arts and Science

BIOL 821  Communication In Biology  Units: 3.00
Oral presentation of research in Biology. Methods for the presentation and critical analysis of research seminars and posters, including preparation of graphical material and the use of microcomputers. This course will run bi-weekly for two terms/1.5 hours per lecture-seminar. Three term hours; fall. R.D. Montgomery.
Offering Faculty: Faculty of Arts and Science

BIOL 822  Long-Term Environmental Change  Units: 3.00
The main focus of this course will be to review and assess the many techniques currently available to track long-term environmental change. An emphasis will be placed on biological approaches dealing with sedimentary analyses, but other proxy methods (e.g. ice cores, bore holes, etc.) will also be covered. General topics to be covered will include climatic change, acidification, eutrophication, lake and reservoir management, UV penetration, etc. Three term hours; fall. Not offered 2010-2011.
Offering Faculty: Faculty of Arts and Science

BIOL 824  Gateway to graduate studies  Units: 3.00
This course will introduce intellectual and professional skills important for success in graduate school and in careers in Biology. Course structure and content is applicable to all fields of biology, from ecology and evolution to cell biology, biochemistry, and molecular biology. Sessions will span topics from study design and hypothesis testing, to communication skills, to career paths and mentoring. The final assignment will be a written research proposal, following the departmental guidelines for the PhD proposal. The goals of the course include 1) introducing graduate students to an array of skills and topics important to their success, 2) helping to develop a community among new graduate students, 3) improving students’ communication skills, and 4) introducing graduate students to several Biology faculty who will lead some of the sessions. Students are required to attend a mandatory weekend at the Queen's University Biological Station, with a cost-recovery fee for accommodation and meals.
Offering Faculty: Faculty of Arts and Science

BIOL 825  Insect Physiology  Units: 3.00
Offering Faculty: Faculty of Arts and Science
BIOL 830  Pop. & Ecological Genetics  Units: 3.00  
Each year brings new molecular tools and significant 
advances in analytical techniques for using molecular data to 
address evolutionary and ecological questions. This course 
is an exploration of these with emphases varying from 
year to year depending on the expertise of the instructor. 
Topics may span natural selection and phenotypic plasticity, 
parentage and mating systems, speciation, hybridization, 
macroevolution, and phylogenetics. Students gain a thorough 
thoretical grounding of pertinent topics via lectures, student 
seminars, and readings from the current primary literature. 
Hands-on analytical experience will be provided through 
student exercises using the latest software applications. Three 
term hours; fall or winter. Not offered 2010-2011.  
Offering Faculty: Faculty of Arts and Science

BIOL 831  Bioremediation  Units: 3.00  
Bioremediation is the use of organisms to alleviate 
environmental problems. Topics will include the biology of 
the organisms involved and their bioremediation processes. 
Plants act to absorb and concentrate heavy metals from 
soils whereas micro-organisms, invertebrates and plants 
degrade organic toxins and remove excess nutrients from 
soils, substrates and water. The processes include extraction, 
absorption, concentration, and degradation of contaminants. 
Three term hours; Not offered 2010-2011.  
Offering Faculty: Faculty of Arts and Science

BIOL 832  Plant Adaptations & Interacts.  Units: 3.00  
Offering Faculty: Faculty of Arts and Science

BIOL 833  Biogeography  Units: 3.00  
Offering Faculty: Faculty of Arts and Science

BIOL 837  Plant Ecology And Evolution  Units: 3.00  
Mechanisms of natural selection involving adaptive strategies 
for growth, survival and reproduction in plants and the 
consequences of this selection on the characteristics of plant 
populations and communities. Recent research topics and 
thoretical developments are stressed. Three term hours; fall. 
L.W. Aarssen.  
Offering Faculty: Faculty of Arts and Science

BIOL 841  Cell Cycle  Units: 3.00  
The cell cycle, its major periodic events, the G0-G1 transition 
and the integration of growth and cell division will be the 
major foci. The course will consider the historical origins of 
the field as well as the modern integration of genetics, cell 
and molecular biology, with respect to the cell cycle. Material 
will be drawn mostly from literature during the previous 
calendar year. Three term hours; fall. Not offered 2010-2011.  
Offering Faculty: Faculty of Arts and Science

BIOL 842  Population Genetics & Molecular Evolution  Units: 3.00  
This course provides an introduction to advanced statistical 
methods (multivariate analysis, randomization methods, 
phylogenetic analysis) and experimental design for biologists. 
The emphasis is on problem solving and the use of 
computers for data acquisition, management, analysis 
and publication. Three term hours; winter. C.G. Eckert.  
Offering Faculty: Faculty of Arts and Science

BIOL 843  Advanced Data Management  Units: 3.00  
This course provides an introduction to advanced statistical 
methods (multivariate analysis, randomization methods, 
phylogenetic analysis) and experimental design for biologists. 
The emphasis is on problem solving and the use of 
computers for data acquisition, management, analysis 
and publication. Three term hours; winter. C.G. Eckert.  
Offering Faculty: Faculty of Arts and Science

BIOL 845  Community And Paleoeology  Units: 3.00  
A variety of quantitative techniques are now being used 
increasingly in the fields of community ecology, paleoecology 
and paleolimnology (e.g. linear and unimodal regression 
and calibration, direct and indirect multivariate ordination, 
quantitative reconstruction models, rate of change analysis 
and analysis of spatial and temporal data). This course will 
investigate these computational techniques and explore 
their applications in the above mentioned fields. This course 
assumes a working knowledge of classical statistics. Three 
term hours; Not offered 2010-2011.  
Offering Faculty: Faculty of Arts and Science

BIOL 846  Field Courses In Biology  Units: 3.00  
This is a two-week field course designed to introduce 
graduate students to field research problems and methods 
in behavioural ecology, ethology, population and community 
ecology, and ecological genetics. The course consists of 
lectures, field research projects and data analysis. Fall/Winter/ 
Spring/Summer. C.G. Eckert, S. Lougheed, R.J. Robertson and 
Y. Wang.  
Offering Faculty: Faculty of Arts and Science

BIOL 847  Environmental Issues  Units: 3.00  
Consideration will be given to environmental, legal, economic, 
political, sociological and biological aspects of current issues 
in the management of the Great Lakes. Models for managing 
nutrients, toxics and fisheries will be compared from a 
multidisciplinary viewpoint. Three term hours; fall. Not 
ofered 2010-2011.  
Offering Faculty: Faculty of Arts and Science

BIOL 849  Advanced Data Analysis  Units: 3.00  
This course provides an introduction to advanced statistical 
methods (multivariate analysis, randomization methods, 
phylogenetic analysis) and experimental design for biologists. 
The emphasis is on problem solving and the use of 
computers for data acquisition, management, analysis 
and publication. Three term hours; winter. C.G. Eckert.  
Offering Faculty: Faculty of Arts and Science

BIOL 850  Darwinism and cultural evolution  Units: 3.00  
Contributions of Darwinian evolutionary theory to the 
understanding of contemporary culture. Through seminars, 
theses, and group discussions, students explore ideas, 
research objectives, and recent discoveries in applying 
Darwinism to the interpretation of cultural products like art 
and literature, social-cultural institutions like religion and 
marketing, societal problems like war and environmental 
conservation, and emerging designs for new models of 
sustainable civilization in the 21st century.  
Requirements: Exclusion BIOL 535  
Offering Faculty: Faculty of Arts and Science

BIOL 851  Vertebrate Zoogeography  Units: 3.00  
Offering Faculty: Faculty of Arts and Science
BIOL 852 Animal Behaviour Units: 3.00
Offering Faculty: Faculty of Arts and Science

BIOL 854 Evolutionary Genetics Units: 3.00
Offering Faculty: Faculty of Arts and Science

BIOL 855 Conservation Biology Units: 3.00
Key issues in conservation biology will be explored in seminars and discussions. Topics will include: minimum viable populations, habitat configuration and sustainable populations, biodiversity, habitat fragmentation, edge effects, keystone species, meta-populations, restoration ecology, endangered species, inbreeding, heterozygosity and fitness, genetics of captive breeding, population genetics and conservation. Three term hours; winter. V.L. Friesen. 
Offering Faculty: Faculty of Arts and Science

BIOL 856 Aquatic Toxicology Units: 3.00
An overview of aquatic toxicology. Topics include pharmacokinetics; mechanisms of toxicity; factors modifying exposure and effects; ecological effects of toxicity; and methods of toxicity testing, bio-monitoring, risk assessment and risk management. The course includes lectures, student seminars and visiting speakers. Three term hours; fall. Not offered 2010-2011.
Offering Faculty: Faculty of Arts and Science

BIOL 860 Introduction to Management & Statistical Analysis of Biological Data Units: 3.00
This course is for students at early stages of planning research and collecting data. Topics include experimental design, matching hypotheses with statistical analyses, parameter estimation and graphing. Analyses will be based on a normal error distribution implemented in the R statistical language. Lectures (3 hrs) & tutorials (3 hrs); First 6 weeks of fall term. Enrolment may be limited. Course weight: 3.0 credit units. EXCLUSION: BIOL-843 
Offering Faculty: Faculty of Arts and Science

BIOL 861 Introduction to Linear Models for Biological Data Units: 3.00
This course is for students with introductory statistics/experimental design training and a working knowledge of the R statistical language, and will cover fitting linear models to continuous data, model selection, diagnosis of key assumptions and data visualization. Lectures (3 hrs) & tutorials (3 hrs). Second 6 weeks of fall term. Enrolment may be limited. Course weight: 3.0 credit units. PREREQUISITES: BIOL-860 or equivalent.
Offering Faculty: Faculty of Arts and Science

BIOL 862 Application of Generalized Linear Models to Biological Data Units: 3.00
Data analysis in Biology often involves counts, densities or proportions that require non-Normal analysis. This course introduce generalized linear models (GLMs) implemented using the R statistical language, including logistic regression, overdispersion and Poisson, quasi-likelihood, negative binomial and mamba models. Lectures (3 hrs) & tutorials (3 hrs). First 6 weeks of winter term. Enrolment may be limited. Course weight: 3.0 credit units
Offering Faculty: Faculty of Arts and Science

BIOL 863 Introduction to Mixed Effects Models for Biological Data Units: 3.00
The course will focus on linear models that include random effects implemented using the R statistical language. Topics will include partitioning of random variance, nested, partially-nested and repeated measures experimental designs, and modern approaches to evaluating competing models. Lectures (3 hrs) & tutorials (3 hrs). First 6 weeks of winter term. Enrolment may be limited. Course weight: 3.0 credit units
Offering Faculty: Faculty of Arts and Science

BIOL 865 Advanced Statistical Analysis of Biological Data Units: 3.00
A course in advanced statistical techniques for biological data. Possible topics include comparative methods, phylogenetic analysis, general additive models, nonlinear regression, network analysis, time series analysis, resampling, path analysis. Topics covered will depend upon student and faculty interests. Lectures & Tutorials (3hrs). Course weight: 3.0 credit units PREREQUISITE: BIOL-860 & BIOL-812 or equivalent
Offering Faculty: Faculty of Arts and Science

BIOL 870 Classical Studies in Molecular Biology Units: 3.00
In this course we will explore advances in molecular biology and genetics with a historical perspective. We will read classical papers outlining major discoveries such as the molecular structure of nucleic acids, the genetic code, the genetic basis of inheritance, and others. Classical studies will be paired with modern studies that build upon these earlier findings. Modern studies will change each year depending on the interests of the students. A major goal of the course is to gain an appreciation for how creativity and carefully designed experiments drive innovation. Students should have foundational knowledge of molecular biology and genetics, as evidence by a BSc degree that included courses in these subjects.
Offering Faculty: Faculty of Arts and Science
BIOL 893  Mentoring Experience in Biology  Units: 0.00
Students will advise and train other students in biological investigations, normally over a two term period. Open to full-time students having completed two terms of study in Biology M.Sc. or Ph.D. programs. Activities include guidance on research proposals, research procedures, student presentations, and drafts of student work. This is a non-credit course, graded on a Pass/Fail basis. PREREQUISITE: Permission of Coordinator of Graduate Studies
Offering Faculty: School of Graduate Studies

BIOL 897  Seminars In Biology  Units: 3.00
Attending a diverse array of seminars is an essential component in the development of a student, especially in a department as diverse as biology. The aim of this course is to develop skills in listening, synthesizing and critical thinking, as well as fostering the development of important oral and written communication skills. Students will be required to attend at least 30 department or specialized research seminars, as well as present a seminar based upon their graduate thesis research. Enrolment is extended over six terms and is limited to new graduate students in Biology. Y. Wang.
Offering Faculty: Faculty of Arts and Science

BIOL 899  Master's Thesis Research  Units: 6.00
Offering Faculty: Faculty of Arts and Science

BIOL 928  Medical Entomology  Units: 6.00
Offering Faculty: Faculty of Arts and Science

BIOL 951  Ecology Evolution & Behav. I  Units: 3.00
Selected topics in ecology, evolution and behaviour. An advanced course on current research in ecology, evolution and behaviour, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; fall. A. Chippindale.
Offering Faculty: Faculty of Arts and Science

BIOL 952  Ecology Evolution & Behav. II  Units: 3.00
Selected topics in ecology, evolution and behaviour. An advanced course on current research in ecology, evolution and behaviour, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; fall. A. Chippindale.
Offering Faculty: Faculty of Arts and Science

BIOL 953  Advanced Studies In Plant Sciences I  Units: 3.00
Selected topics in plant sciences. An advanced course on current research in plant science, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; T.B.A. P. Grogan.
Offering Faculty: Faculty of Arts and Science

BIOL 954  Advanced Studies In Plant Sciences II  Units: 3.00
Selected topics in plant sciences. An advanced course on current research in plant science, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; T.B.A. P. Grogan.
Offering Faculty: Faculty of Arts and Science

BIOL 955  Advanced Studies in Cellular & Molecular Biology I  Units: 3.00
Selected topics in molecular biology. An advanced course on current research in molecular biology, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; fall. L. Seroude.
Offering Faculty: Faculty of Arts and Science

BIOL 956  Advanced Studies in Cellular & Molecular Biology II  Units: 3.00
Selected topics in molecular biology. An advanced course on current research in molecular biology, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; winter. Y. Wang.
Offering Faculty: Faculty of Arts and Science

BIOL 957  Advanced Studies in Animal Physiology I  Units: 3.00
Selected topics in animal physiology. An advanced course on current research in animal physiology, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; winter. Y. Wang.
Offering Faculty: Faculty of Arts and Science

BIOL 958  Advanced Studies in Animal Physiology II  Units: 3.00
Selected topics in animal physiology. An advanced course on current research in animal physiology, based on recent research literature. For detailed information, consult the course coordinator. Three term hours; winter. Y. Wang.
Offering Faculty: Faculty of Arts and Science

BIOL 959  Environmental Sciences I  Units: 3.00
Selected topics in environmental sciences. An advanced course on current research in environmental sciences. For detailed information, consult the course coordinator.
Offering Faculty: Faculty of Arts and Science

BIOL 960  Environmental Sciences II  Units: 3.00
Selected topics in environmental sciences. An advanced course on current research in environmental sciences. For detailed information, consult the course coordinator.
Offering Faculty: Faculty of Arts and Science

BIOL 999  Ph. D. Thesis Research  Units: 6.00
Offering Faculty: Faculty of Arts and Science